IN THE

Supreme Court of the United States

OCTOBER TERM, 1969.

No. 1412

INDIANA GENERAL CORPORATION,
Petitioner,

vs.

KRYSTINEL CORPORATION,
Respondent.

PETITION FOR WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SECOND CIRCUIT.

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April 9, 1970

THE GUNTHORP-WARREN PRINTING COMPANY, CHICAGO

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PETITION FOR WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SECOND CIRCUIT.

Petitioner, Indiana General Corporation, plaintiff below, respectfully prays for issuance of a Writ of Certiorari to review the Judgment and Order of the Court of Appeals for the Second Circuit, entered January 14, 1970.

I. ORDERS, OPINIONS AND JUDGMENTS BELOW.

The Opinion and Mandate of the Second Circuit Court of Appeals, Appeals Nos. 33,486 and 33,535, was decided January 14, 1970, is not officially reported as of this date, and is unofficially reported at 164 U. S. P. Q. 321. The Opinion has been set forth in the Appendix (pp. A1-22).

An Order entered February 13, 1970 stayed the Mandate to March 14, 1970, pending this application for Writ of

Certiorari; and a further Order dated March 19, 1970 extended such time to April 14, 1970.

The Opinion of the United States District Court for the Southern District of New York was dated November 20, 1968, and is officially reported at 297 F. Supp. 427 (Appendix, pp. A25-60). The Judgment of the District Court, entered November 21, 1968, dismissed the Complaint. Responsive to timely motions to amend and supplement findings and conclusions, a Memorandum Opinion was entered by the District on February 17, 1969, officially reported at 297 F. Supp. 448 (Appendix, pp. A62-66).

II. STATEMENT OF GROUNDS ON WHICH JURISDICTION OF THIS COURT IS INVOKED.

Sought to be reviewed is the decision, judgment and mandate of the Second Circuit Court of Appeals, dated and entered January 14, 1970. Jurisdiction to review by Writ of Certiorari is conferred by 28 U. S. C. § 1254(1).

III. QUESTIONS PRESENTED FOR REVIEW.

1. The Court of Appeals has decided a federal question in a way in conflict with applicable decisions of this Court. The question below was, and the principal question here is, whether a composition of matter, never known before and having beneficial properties and characteristics never achieved before in its field of use, should be held validly patented under this Court's decision in *United States* v. *Adams*, 383 U. S. 39, decided upon the principles announced in *Graham* v. *Deere*, 383 U. S. 1. The question is whether the Circuit Court of Appeals' decision is in conflict with the cited decisions of this Court, and whether certiorari should be granted under Rule 19(1)(b) of the Rules of the Supreme Court on that account.

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2. The Court of Appeals for the Second Circuit has rendered a decision in a matter of federal law relating to validity of a patent on a composition of matter which is in conflict with the decision of the United States Court of Appeals for the District of Columbia in *Commissioner of Patents* v. *Deutsche Gold-Und-Silber-Scheideanstalt Vormals Roessler*, 397 F. 2d 656 (1968). Is not the decision below incorrect and that of the Court of Appeals for the District of Columbia in conformity with this Court's decisions in *Graham* v. *Deere* and *United States* v. *Adams* so that there is conflict between the Circuits, in principle, of the application of 35 U. S. C. § 101 and § 103? Should not certiorari therefore be granted under Rule 19(1)(b) of the Rules of the Supreme Court?

3. Should certiorari be granted, it would be Petitioner's intent to present for review the sufficiency of the patent in suit under the provisions of 35 U. S. C. § 112, and the right of the patent in suit to the benefit of earlier filing dates in the United States and Germany under 35 U. S. C. § 119 and § 120.

IV. STATUTES INVOLVED.

The statutes involved are 35 U. S. C. § 101, 35 U. S. C. § 103, 28 U. S. C. § 1254(1), and Supreme Court Rule 19(1)(b), set out below.

66 Stat. 797 (1952), 35 U. S. C. § 101 (1964);

"§ 101. Inventions patentable

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title."

66 Stat. 798 (1952), 35 U. S. C. § 103 (1964);

"§ 103. Conditions for patentability; non-obvious subject matter

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made."

62 Stat. 928 (1948), 28 U. S. C. § 1254(1);

"§ 1254. Courts of appeals; certiorari; appeal; certified questions

Cases in the courts of appeals may be reviewed by the Supreme Court by the following methods:

(1) By writ of certiorari granted upon the petition of any party to any civil or criminal case, before or after rendition of judgment or decree;"

Supreme Court Rule 19(1)(b)

"Rule 19. Considerations Governing Review on Certiorari

1. A review on writ of certiorari is not a matter of right, but of sound judicial discretion, and will be granted only where there are special and important reasons therefor. The following, while neither controlling nor fully measuring the court's discretion, indicate the character of reasons which will be considered:

• • • • •

(b) Where a court of appeals has rendered a decision in conflict with the decision of another court of appeals on the same matter; or has decided an important state or territorial question in a way in conflict with applicable state or territorial law; or has

decided an important question of federal law which has not been, but should be, settled by this court; or has decided a federal question in a way in conflict with applicable decisions of this court; or has so far departed from the accepted and usual course of judicial proceedings, or so far sanctioned such a departure by a lower court, as to call for an exercise of this court's power of supervision."

V. STATEMENT OF THE CASE.

A. **Proceedings in This Case**—In February, 1963, Petitioner filed a civil action against Respondent in the Southern District of New York alleging infringement of United States Patent No. 3,036,009, patented May 22, 1962, which is the patent in suit. A trial was had during five days at the end of February and beginning of March, 1968. Post-trial briefs and suggested findings of fact and conclusions of law were submitted by both parties after the close of evidence.

On November 20, 1968, the District Court filed its Opinion, holding the patent invalid under 35 U. S. C. § 103 and § 112; and denying the patent the benefit of its earlier filed United States and German applications. This earlier filing date, if given, would have negatived the effect of Petitioner's sales of the product covered by the patent held to invalidate the patent under 35 U. S. C. § 102(b). Some modifications of the Findings and Conclusions, not involved in this Petition, resulted from motions under F. R. C. P. 52(b), and the District Court filed its Memorandum Opinion thereon on February 17, 1969. An appeal followed which was argued in the Court of Appeals for the Second Circuit on October 30, 1969. The Court rendered its Opinion January 14, 1970. The Mandate has been stayed to permit this Petition for Certiorari.

B. **Nature of the Patent in Suit**—The patent in suit involves a composition of matter made up of particular metallic oxides which are mixed and chemically reacted at high temperature by firing in a kiln. Once fired, the beginning oxide constituents lose their identity and a true chemical composition of matter is formed.

The particular ferrite here involved is made from five starting metallic oxides. Most of the composition comprises oxides of iron, zinc and nickel, with the iron being present in larger quantity than the zinc or nickel. Relatively small quantities of the oxides of cobalt and manganese are mixed with the iron, zinc and nickel. Each of the five oxides are within stated proportions set forth in the one claim of the patent in suit. There are other important limitations: the iron oxide of the ferrite is to be at least 50 mol percent; the manganese oxide is to be 1 to 5 weight percent; and the cobalt oxide is to be 0.1 to 3 percent by weight of the total composition and to have a stated relationship to the amount of nickel oxide present. No prior literature, patent or art described a ferrite of these particular five constituents, let alone such a composition in the proportions specified by the patent in suit.

This ferrite has many uses in electronics. One of the first commercial uses of one composition within the patent coverage was as an antenna rod in relatively small radio receiving sets. Prior antenna rods of different ferrite materials had failed, being time and temperature unstable and of relatively poor operational quality. The ferrite material, in the shape of a pencil or as a flat wafer, was used by winding a few turns of wire about it to form the antenna for the radio. The ferrite material presents less resistance to the passage of radio waves than does surrounding air (measured by the term "permeability"). The waves, cutting across the turns of wire, induce a current

which is carried into other circuits of the radio for amplification to audible sound.

The new patented ferrite material was a "soft" ferrite, one temporarily magnetic when the radio waves pass through it. Properly matched in impedance with the radio circuit, the ferrite core antenna worked well and permitted much smaller radios to be made. The radio manufacturers replaced a large coil of wire wound on a cardboard holder, requiring a large amount of space, with the new, small ferrite rod or wafer.

Radio waves are weak, so that energy therefrom has to be concentrated and not lost. The new ferrite material has a low loss factor, the inverse of which is called "Q-factor", loosely termed "quality factor", which is the measure of low energy loss.

. . .

After World War II, ferrite technology from Europe was brought to this country. Petitioner had a working arrangement with Steatit-Magnesia Aktiengesellschaft of Germany (Stemag). The patent in suit came from Mr. Zerbes, a Stemag employee. Zerbes' compositions worked where all others had failed.

C. **Nature of the Prior Art**—The prior art referred to by the Court of Appeals is a page of an RCA article in 1950; three patents, filed respectively in 1949, 1951 and 1952; and Petitioner's prior commercial product, which failed and was displaced by a product made under the patent in suit.

The 1950 RCA article, page 344, shows a number of different two-component ferrites; in other words, iron oxide and one other metallic oxide combined with the iron (Appendix, pp. A89-90).

Berge patent 2,656,369 (Appendix, pp. A75-78) mentioned making ferrites of various oxides but does not mention manganese oxide as one of them. The patent does mention

oxides of iron, nickel, zinc, vanadium, magnesium and cobalt.

The Crowley patent 2,736,708 (Appendix, pp. A79-84) states generally that various metallic oxides can modify the magnetic properties of a ferrite, among which are the oxides of cobalt, manganese, chromium and nickel. No details are given as to this generalized statement. The patent does show that nickel oxide, added to the oxides of iron and zinc, produces a ferrite with certain test results; and that cobalt oxide added to the oxides of iron and zinc produces a ferrite with similar but less effective test results.

The Harvey patent 2,723,239 (Appendix, pp. A85-88), issued to RCA, states that the addition of cobalt oxide to a zinc-magnesium-nickel ferrite of specific proportions effects some change in quality; and further states in effect that the use of manganese oxide, as well as copper oxide and silicon oxide, should be avoided.

Petitioner's commercial product, which preceded the invention of the patent in suit, contained no cobalt or cobalt oxide whatsoever. While the product was made and sold, it was a commercial failure, was unstable, changed impedance with passage of time and change in temperature and was adversely affected by normal shocks occurring in transport (Appendix, pp. A7-8; 29).

VI. REASONS FOR GRANTING THE WRIT.

A. Conflict With Decisions of This Court.

The decision of the Court of Appeals for the Second Circuit decides a federal question of patentability under 35 U. S. C. § 103 in a way in conflict with decisions of this Court in *United States* v. *Adams*, 383 U. S. 39, and *Graham* v. *Deere*, 383 U. S. 1. For this reason, this Court is re-

quested to grant a writ of certiorari under the provisions of its Rule 19(1)(b).

Justice Clark, in writing the decision for the Court in *United States* v. *Adams*, stated at the outset that the case was controlled on the merits by the decision in *Graham* (383 U. S. at 41). The factual inquiries recited in *Graham*, 383 U. S. at 17, included a trilogy of: a determination of the scope and content of the prior art; the differences between the prior art and the claims at issue; and a resolution of the level of ordinary skill in the pertinent art.

The second item of the trilogy refers to "differences", whereas 35 U. S. C. § 103 refers to the "subject matter as a whole" as that subject matter about which obviousness or non-obviousness is to be determined.

In *United States* v. *Adams*, this Court did consider the "subject matter as a whole" in deciding that the battery of Adams was non-obvious. In contrast, the Court of Appeals for the Second Circuit, in the instant case, has held the patent in suit invalid by saying that the difference between one prior compound and the patented compounds is the presence therein of cobalt oxide, which oxide was a known ingredient usable in ferrites, so that this difference was obvious. There was no consideration of the composition of matter as a whole.

Justice Clark has now spoken on the patentability of a composition of matter from the bench of the Court of Customs and Patent Appeals, *Application of Wiggins*, 397 F. 2d 356 (1968), making it clear that this Court's decisions in *Graham* and *Adams* require a consideration of the subject matter as a whole, not just the differences, in resolving the question of obviousness or non-obviousness under 35 U. S. C. § 103.

In *Adams,* battery electrodes of magnesium and cuprous chloride were both known to exist, but were not shown together in one battery. It was not the chemical make-up of the electrodes or of the battery that sustained the patent, it was instead the operational characteristics, in short, the non-obvious properties. As this Court said at 383 U. S. 51:

> "We conclude the Adams battery was also non-obvious. As we have seen, the operating characteristics of the Adams battery have been shown to have been unexpected and to have far surpassed then-existing wet batteries."

In contrast to *Adams,* the Court of Appeals in the instant case drew particular attention to the chemical metallic oxides which were going into the composition of matter claimed in the Zerbes patent in suit. Thus, in its Opinion[1] the Court carefully set out the compositions of Petitioner's former unsuccessful "Ferramic N" product, showing that it had no cobalt oxide whatsoever, and compared it with the commercial "Ferramic Q", made under the patent in suit, which had both cobalt oxide and manganese oxide. The Court states that these formulas were critical because the "N" product had manganese in it. It still remained that no one and no prior art had ever before used both manganese and cobalt oxides together in a ferrite. Neither had they been used with the oxides of iron, nickel and zinc, nor in the proportions claimed in the patent in suit. More importantly, no ferrite had achieved time, temperature and shock stability while exhibiting very low loss factor (high Q-value).

In considering a chemical composition of matter, its characteristics and properties cannot be separated from the chemical formula. Non-obviousness cannot be judged

1. Appendix, p. A9.

from the formula alone; for if this were so, this Court could not have rationally held the Adams battery to be the subject of a valid patent. Non-obviousness was decided on the operational characteristics of the battery together with its chemical constituents of anode, cathode and electrolyte constituting the "subject matter as a whole".

The foregoing proposition has been made most clear by Justice Clark's decision in *Application of Wiggins*, 397 F. 2d 356 (1968). The subject matter of the application was a particular chemical compound which exhibited analgesic activity and the ability to alleviate headache pain in humans.[2] The Court found that an article by Wolf, which was prior, showed that the "identical compound employed by appellant . . . was known to protect mice against the effects of X-ray radiation".[3] The difference between the article and the claimed compound was one relating primarily to the dosage used for humans and the dilutant in which the compound was placed for human consumption. The prior article had not recognized that the compound had any use for humans or that it was anything but pharmacologically inert.

Justice Clark, with the slight difference that did exist and with the discovery of the *property* of the compound for relieving headaches, cited this Court's decision in *United States* v. *Adams* and reached the decision that the patent should be granted, stating at 360:

> "Section 103 of the 1952 Patent Act provides that a patent may not be obtained 'if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art.' In light of the background of the subject

2. 397 F. 2d at 357.

3. *Ibid.*

> matter here, the content of the prior art and the differences between it and appellant's claims, we cannot say that the discovery of appellant was obvious to one skilled in the art."

This in spite of the fact that the identical compound was shown by its chemical constituents to be old, but recognizing that the subject matter as a whole required the consideration of the properties and operational characteristics of that compound. Non-obviousness was not decided on the basis of the chemical constituents alone.

In the present case, the operational characteristics and properties of compounds made under the patent in suit were not considered in deciding the question of obviousness. In the Court of Appeals' decision,[4] the former products on the market were recited as unsuccessful in accordance with the evidence. It recites that the competitors of Petitioner had not developed any ferrites to solve the problem.[5] The new product under the patent in suit is said to have met with commercial acceptance,[6] citing that Zenith had approved its purchase and the evidence showing that other large radio manufacturers had done likewise, thus reversing a then current trend back to the cardboard wound wire antennas. Note is made that the new composition had the effect of greatly improving the Q-factor.[7] Contrary to the Court of Appeals for the Second Circuit holding, the new compound had a *lower permeability* than its predecessors. The evidence shows that the new composition enjoyed a practical monopoly for three years until Respondent entered the field, and that such position in the marketplace was due solely to the

4. Appendix, p. A7.
5. Appendix, p. A8.
6. Appendix, p. A10.
7. Appendix, pp. A8-9.

excellence of the product, there being no substantial advertising or sales efforts.

In applying the "rubric of *Graham* v. *John Deere Co.*", the Court of Appeals[8] merely examined the difference between Petitioner's former "N" product and its new product under the patent in suit, and called this "no more than the addition of the small amount of cobalt oxide". The Court attributes the addition of cobalt oxide with that which is taught by Crowley. In the words of this Court in *Adams,* if the substitution were that of equivalent chemical compositions, then an equivalent operational characteristic ought to result. Crowley only improved quality of his ferrite by 30% maximum. Zerbes' composition was far superior—by combining the five metallic oxides Zerbes obtained quality improvements of the order of several times that much, specific examples in the patent in suit showing improvements up to 214%. Crowley did not achieve operational results equivalent or even approaching those of the patent in suit. The patent in suit's results were not only much better, but as manufactured by Petitioner, the compositions worked against failure of its own former compositions and failure of its competitors' compositions. Crowley was one of those competitors whose product was displaced in the marketplace by Zerbes' new composition.

Had the Court of Appeals for the Second Circuit followed the decisions of this Court in *Adams* and *Graham,* it would have decided the federal question of patentability under 35 U. S. C. § 103 by considering the subject matter as a whole, *i.e.,* not only the formula of the ferrite but its operational characteristics and properties as well. When so considered, the patent should be held valid in accordance with the principles laid down in *United States* v.

8. Appendix, p. A12.

Adams. A Writ of Certiorari should be granted because of the conflict of the decision of the Court of Appeals with the former decisions of this Court.

B. Conflict With Decisions of Another Court of Appeals.

The Court of Appeals for the Second Circuit has rendered a decision in this case in conflict with a decision of the Court of Appeals for the District of Columbia in *Commissioner of Patents* v. *Deutsche Gold-Und-Silber-Scheideanstalt Vormals Roessler*, 397 F. 2d 656 (1968). For this reason, this Court is requested to grant a Writ of Certiorari under the provisions of its Rule 19(1)(b).

The decision of the Court of Appeals for the District of Columbia in *Deutsch* is consistent with a line of decisions decided under 35 U. S. C. § 103 in conformity with this Court's decisions in *Graham* v. *Deere* and *United States* v. *Adams*. The consistency of the Court of Appeals for the District of Columbia dates from before this Court's decisions in *Graham* and *Adams*.[9] Its decision in *Deutsche* indicates an awareness of this Court's directives for deciding non-obviousness in chemical composition of matter cases; whereas the Court of Appeals for the Second Circuit in the instant case has ignored those directives and decided the instant case in contrast to the decision of the Court of Appeals for the District of Columbia.

If the Court of Appeals for the District of Columbia is consistently directing the Commissioner of patents to issue chemical composition of matter patents following the directives of *Graham* and *Adams*, and the Court of Appeals for the Second Circuit is going to declare chemical composition of matter patents invalid because of a different

9. *E. I. DuPont de Nemours and Company* v. *Ladd*, 328 F. 2d 547, 554 (D. C. Cir. 1964).

application of 35 U. S. C. § 103, there results a conflict which must be corrected.

The problem here is one of structural obviousness of a compound, the properties of which are non-obvious. The structural obviousness may be the result of knowledge that the components which go to make up the compound are known; or "Structural obviousness generally arises because the claimed compound is—in the chemists' jargon—a homolog, analog, or isomer of the prior art references."[10] In the instant case, the ferrite patent in suit has been declared invalid on the basis of its structural obviousness alone. In other words, each of the individual metallic oxides were known. The Court said that to find the proportions of them that would be efficacious would have been an obvious matter (Appendix, p. A15), ignoring the fact there was no teaching that the 5 oxides should be put together and ignoring the fact there was no prior knowledge that such beneficial operating characteristics could be achieved.

In *Deutsche,* the court referred to the decision of this Court in *Graham,* to the trilogy of inquiry which forms the "background" for determination of obviousness. The court stated that "It seems rather elementary to us that the 'background' referred to for determination of obviousness clearly is not limited to the issues of structural similarity."[11]

The properties of a chemical composition are a part of it, inseparable from it, and are not simply secondary evidences of invention, such as "commercial success". The plain language of 35 U. S. C. § 103 makes it clear that obviousness of the subject matter as a whole is not limited

10. *Commissioner of Patents* v. *Deutsche Gold-Und-Silber-S., Etc.,* 397 F. 2d 656 (D. C. Cir. 1968) at 661.

11. *Ibid,* at 662.

to a consideration of structure.[12] In *United States* v. *Adams,* the patent on the battery was not sustained because the structure was new—the structure was old. The chemical constituents of the electrodes were also old, but because Adams had put them together and obtained properties which were different, better and unexpected, the patent validity was upheld.

The Court of Appeals for the District of Columbia has stated that that court and the Court of Customs and Patent Appeals for some years had been of the view that patentability was not to be determined on the basis of structural obviousness alone.[13] Reliance is had on Judge Rich's decision in *Application of Papesch,* 315 F. 2d 381 (C. C. P. A. 1963). In that decision, the unobviousness and patentability of chemical compounds is said to be determined by taking into consideration the properties and is not to be determined on the basis of structure alone. The case states that where patentability has been found, it was found in spite of the close similarity of chemical structure to compounds in the prior art.[14]

The Court of Appeals for the District of Columbia in *Deutsche* states that it is following the decisions of this Court in *Graham* and *Adams,* and that the Court of Customs and Patent Appeals agrees, citing *Papesch.* Judge Rich, who wrote the *Papesch* decision, states in a later decision[15] that its line of cases, including *Papesch,* was following the rationale of the Court of Appeals for the Second Circuit in *Schering Corporation* v. *Gilbert,* 153 F. 2d 428, 430 (1946), wherein on the question of patentability of a

12. *Ibid,* at 663.

13. *Ibid,* at 661.

14. *Application of Papesch,* 315 F. 2d at 397.

15. *Application of Lundsford,* 357 F. 2d 380, 384-385 (C. C. P. A. 1966).

compound proved to possess unobvious and highly useful properties, the majority stated:

> "* * * it is necessary to understand what the inventors did as well as what they sought to accomplish and *give recognition to their end result* as a novel and useful improvement, not in the art of organic chemistry but in that of cholecystography." (Emphasis added.)

In *Schering*, the Court of Appeals for the Second Circuit decided before the 1952 Patent Act that the validity of a patent on a composition of matter had to be decided by considering the properties as well as the structure of the composition. In the instant case, the fact that this 5-metal oxide ferrite produced quality factors never before attained, was stable against passage of time, kept its impedance relationship with the rest of the radio circuits even though jarred in transit, and was temperature stable, all of which are properties not possessed by prior ferrites, is ignored by the Court and the compound was declared obvious on the basis of its structure alone. If certiorari is granted, this Court will have the opportunity to direct the courts below to determine obviousness on the basis of structure alone, or to affirm the position of the Court of Appeals for the District of Columbia that non-obviousness under 35 U. S. C. § 103 shall be determined for chemical compositions by considering both structure and properties of the compound.

The entire pharmaceutical industry and a great portion of the chemical industry will be affected should this Court decide that non-obviousness of chemical compositions should be decided on structure alone, as the Court of Appeals did in the instant case. Virtually all chemical compositions are nothing more than a combination of elements, all of which elements are old per se. Unless the properties, the effectiveness, the degree to which such com-

positions may produce new effects, and like characteristics of such compounds can be considered, none would be patentable nor would patents on any be sustained.

CONCLUSION.

Petitioner respectfully requests that this Petition for a Writ of Certiorari be granted.

Respectfully submitted,

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April 9, 1970.

APPENDIX A.

UNITED STATES COURT OF APPEALS

For the Second Circuit.

Nos. 116, 117—September Term, 1969.

(Argued October 30, 1969 Decided January 14, 1970.)

Docket Nos. 33486, 33535

INDIANA GENERAL CORPORATION, A Corporation,
Plaintiff-Appellant,

—vs.—

KRYSTINEL CORPORATION, A Corporation,
Defendant-Appellee.

Before:

MEDINA, MOORE and FEINBERG,
Circuit Judges.

Appeal and cross-appeal from a judgment of the United States District Court for the Southern District of New York, Charles H. Tenney, *Judge.*

Indiana General Corporation appeals from a judgment holding United States Patent No. 3,036,009 invalid and three of the accused products of Krystinel Corporation non-infringing. Krystinel Corporation cross-appeals from that part of the judgment holding that one of its accused products would have infringed the patent if it were held to be

valid and that Indiana General and its assignors did not engage in fraudulent conduct in their dealings with the Patent Office, and denying Krystinel's application for attorneys' fees. Affirmed. Opinion below reported at 297 F. Supp. 427 (S. D. N. Y. 1969).

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HARVEY E. BUMGARDNER, JR., New York, N. Y. (Ira J. Krakower, Martin J. Cohen, and Arthur, Dry, Kalish, Taylor & Wood, New York, N. Y., on the brief), *for defendant-appellee.*

MEDINA, *Circuit Judge*:

The isue involved in this case is the validity of United States Patent No. 3,036,009, issued to Georg Zerbes for the invention of a five-oxide component soft ferrite manifesting a high Q-factor at high frequencies and assigned by him to Indiana General Corporation, plaintiff-appellant. The court below, Judge Tenney sitting without a jury, held the patent invalid. Opinion reported at 297 F. Supp. 427 (S. D. N. Y. 1969). Judge Tenney concluded that the patent was invalid under 35 U. S. C. Section 112 in that it included overly broad statements and misrepresented the scope of the inventive advance; under 35 U. S. C. Section 102 because of commercial use for more than one year before August 11, 1958, the filing date of the continuation-in-part application which eventually became the patent in suit; under 35 U. S. C. Section 112 for claiming a utility not sup-

ported by the specification and known by Zerbes at the time the first application for a patent was filed in the United States on November 9 1954; and under 35 U. S. C. Section 103 for obviousness in view of the state of the art as it existed prior to November 27, 1953, the date on which the original application for a patent was filed in West Germany. Judge Tenney also held that Krystinel Corporation's accused products K-401-1, K-411, and K-502 were non-infringing. However, he concluded that Krystinel's K-401, discontinued on November 1, 1963, would have infringed the patent if the patent was held to be valid. He also concluded that Indiana General, its corporate predecessor General Ceramics Corporation, and Zerbes did not engage in fraud before the Patent Office although their concealment of certain facts rendered their conduct less than candid, and that the case was not "exceptional" within the meaning of 35 U. S. C. Section 285 to warrant the awarding of attorneys' fees to Krystinel. Although, in affirming the judgment below we conclude that Judge Tenney's findings of fact are not "clearly erroneous" and that his conclusions of law are correct, we find it necessary to discuss only the issue of obviousness.

I.

Discussion of Relevant Technical Terms.

The invention to which the patent in suit relates is a soft ferrite which allegedly has a high Q-factor in high frequency communication applications.[1] In order to under-

1. The patent made only one claim, which reads as follows:

I claim:

A magnetic core body having a high Q-factor in the high frequency range of up to 300 mcs. comprising a sintered nickel-zinc ferrite prepared by firing at about 1100° C. to about 1350° C. a composition consisting essentially of the NiO, ZnO and ferric oxide components set forth in weight percent within the area A—B—C—D of the drawing, said composition com-

stand the interaction of the patent in suit with the prior art, it is essential that the characteristics of soft ferrites and their relevant magnetic properties be explained.

A ferrite is a chemical composition containing iron (ferric) oxide and other metallic oxides which is magnetic although not metallic. "Soft" ferrites are temporary magnets; they become magnetized when an electric current or radio waves pass through them and lose most of their magnetism when such passage ceases. "Hard" ferrites are permanent magnets.

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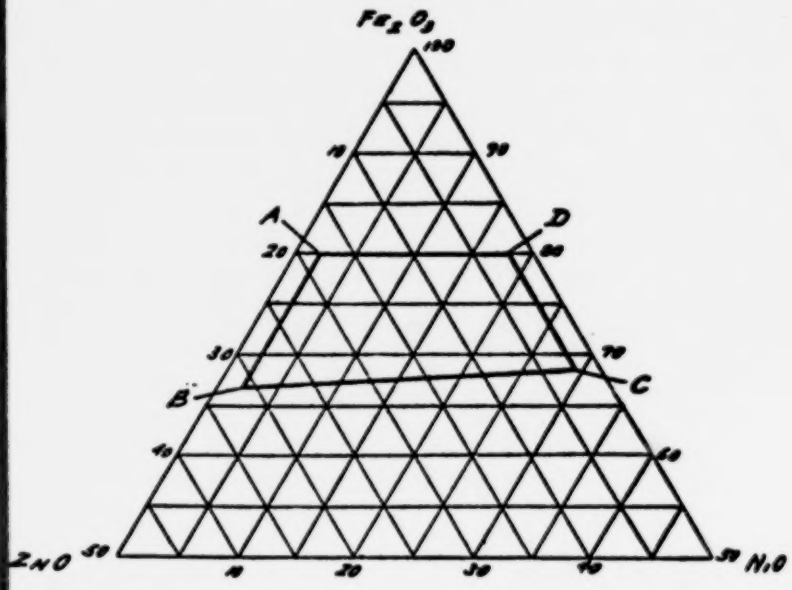
prising in addition 1 to 5 weight percent of manganese oxide based on the total weight percent, and 1-60% by weight of cobalt oxide based on the proportion of nickel oxide in the said composition, the amount of cobalt oxide being within 0.1 to 3.0% by weight of the total composition, the proportion of iron oxide in said batch being at least 50 mol percent of the entire composition.

The triaxial diagram referred to in the claim is set forth below:



The ferrites here involved have an "inverse spinel" structure. Their formula is $MO \cdot Fe_2O_3$, where M represents any divalent metallic ion. A divalent metallic ion is one in which two electrons have been given up to form a neutral compound. Examples of such ions are cobalt (Co^{2+}), manganese (Mn^{2+}), zinc (Zn^{2+}), and nickel (Ni^{2+}). Each of these ions displays different magnetic properties.

The inverse spinel structure is cubic and crystalline, and the geometrical arrangement of the iron and divalent metallic ions and the oxygen ions within the crystal is responsible for the various magnetic properties of the substance. Generally some of the iron ions form a cube within which other iron ions, the ions of the divalent metals, and oxygen ions are arranged. Within the cubic structure, oxygen ions are closely packed together; and the iron ions, obtained from ferric oxide, and the divalent metallic ions are situated at interstices of lattices formed by the oxygen ions. There are two types of interstices, called A sites and B sites. An inverse spinel ferrite contains twice the number of B sites as A sites. In such a ferrite the iron ions occupy all the A sites and one-half the B sites. Consequently, the number of iron ions occupying the A sites is equal to the number occupying the B sites.

The interactions between the metallic ions of the A and B sites are very numerous, so much so that all other ionic interactions are relatively unimportant. Because the iron ions are arranged in opposite alignments on the A sites and the B sites, they cancel each other out. As a result, the magnetic properties of an inverse spinel ferrite are largely determined by the magnetic properties of the divalent metallic ions—*i.e.*, cobalt, manganese, zinc, nickel, magnesium, vanadium, and copper ions—occupying the remainder of the B sites.

These data are the A B Cs of the art. Those skilled in the arc are physicists, chemists and chemical engineers such as most of those who testified at the trial. In due course we shall discuss the investigation of the practitioners of this art and the nature of the progress made in the development of the art that constitute the background against which the issue of obviousness must be adjudicated.

The importance of soft ferrites in high frequency communication applications is derived from their high resistivity. [2] The reason is that this property causes the material to be more efficient by having low eddy-current losses. The result is that less power is wasted, and the time lag in the operation of a given electrical device is decreased. Also important is the existence of high permeability and high quality factor. Permeability, symbolized by the Greek letter Mu (μ), is a measure of the ability of a given material to concentrate magnetic lines of force. It is the ratio of the flux (lines-of-force) density of the material in a given magnetic field compared with the flux density of air in the same field. Because radio and other electromagnetic waves have a magnetic component as well as an electric component, permeability can also measure the ability of a substance to concentrate such waves. Quality factor (the "Q-factor") is the inverse of loss factor, which is the amount of energy dissipated when magnetic lines of force or electromagnetic waves pass through it. Thus, a high quality factor indicates a material which loses relatively small amounts of energy. A ferrite with high permeability and high quality factor at high frequencies is efficient and well suited to use as a radio antenna.

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2. *See* J. Thompson, The Magnetic Properties of Materials 55 (1968); A. Morrish, The Physical Principles of Magnetism 489 (1965); R. Bozorth, Ferromagnetism 244 (1951).

II.

The Development of the Patent in Suit.

As the ensuing discussion will make too apparent, the patent in suit had a rough voyage through the Patent Office and was finally issued only after the Commissioner had overruled the Examiner, who had protected again and again that the combination of elements whose properties were already well known and described in the prior art should not override the claim of obviousness. Accordingly, we think it helpful to discuss the course of Indiana General's experimentation with various types of ferrites and the progress of this particular alleged invention over a period of many years in the Patent Office.

The events which led to the development of United States Patent No. 3,036,009 were part of an effort by physicists, chemists and chemical engineers in the United States and Europe to discover the properties of ferrites and make them more efficient. Prior to the development of the material which formed the basis for the patent in suit, General Ceramics Corporation, one of Indiana General's corporate predecessors, marketed ferrites under the trade names of Ferramic J and Ferramic N. The former was put on the market in 1951 and the latter in 1952. Neither was commercially successful, although Ferramic N was better suited to use in radio antennas than Ferramic J. Among the major shortcomings of Ferramic N were its tendencies to become unstable because of changes in temperature, lapse of time (disaccommodation), and shock, as from the bumping of a delivery truck on an uneven road. It also had a relatively low Q-factor at 1 mc., which was then considered a high frequency, although it had a relatively high permeability. Various attempts were made to improve the stability of Ferramic N, such as by artificially aging the antenna rods which comprised it. The results of these efforts were not satisfactory.

Appellant Indiana General claims that by the middle of 1953 none of its competitors had developed a ferrite which solved the problems with which Ferramic N was afflicted. Working on improvements in ferrites were such persons as Jacob L. Snoek of the Netherlands, working for Philips Research Laboratories; Godshalk Berge; Robert L. Harvey, working for Radio Corporation of America; and Dr. Ernst Albers-Schoenberg, Director of Research for General Ceramics.

General Ceramics had an agreement for the exchange of technical data with a West German corporation, Steatit-Magnesia Aktiengesellschaft ("Stemag"). The evidence indicates that during the summer of 1953 Dr. Albers-Schoenberg made one of a series o fannual visits to Stemag. At that time he spoke to George Zerbes and found that the latter had come across a composition which added small quantities of cobalt oxide and manganese oxide to a nickel-zinc ferrite, allegedly resulting in a dramatic improvement in Q-factor at 1 mc. Dr. Albers-Schoenberg reported this development to Salvatore J. Ortepio, then a project engineer for General Ceramics, by letter of August 5, 1953, which stated in pertinent part:

> The Stemag people have found, that a very small addition of Cobalt oxide (below 1%) improves greatly the Q-factor and temp. coefficient of antenna body. * * * (This is almost 874-body.) [General Ceramics' code name for Ferramic N].

Keenly interested in this development, Ortepio assigned work on this product to a Dr. Wetzel. Laboratory samples were prepared, and their Q-factors were measured. Finally, in October 1953 the decision was made to produce a commercial-sized batch of 300 kg. Parts of the batch were sent to certain radio manufacturers with a specification sheet dated November 18, 1953, identifying the product as 2017-C with trade name of Ferramic Q. Its Q-factor was reported to be 470 at 1 mc.

The comparative chemical compositions of Ferramic N an Ferramic Q by weight per cents are as follows:

	Ferramic N	Ferramic Q
Fe_2O_3	75.50%	75.14%
NiO	9.20%	9.06%
ZnO	13.50%	14.05%
MnO	1.80%	1.40%
CoO	———	0.88%

While the details will be considered later on in this opinion, it is important to note at this point, and to bear in mind throughout that this combination is critical to the issue of obviousness. It is critical because Ferramic N contains a small amount of manganese oxide (MnO) and to this combination is now added a small amount of cobalt oxide (CoO) which has the effect of greatly improving the Q-factor. This is precisely the teaching of the Crowley Patent (2,736,708, filed June 8, 1951). Whether or not Zerbes knew of the Crowley application when he is said to have found the new composition does not appear, nor is it material on the issue of obviousness, for the question is not what was or was not obvious to a particular person possessed of more or less limited knowledge of the prior art, but what would have been obvious to a hypothetical person who did have knowledge of the prior art.

On November 27, 1953, Stemag and Steatite Research Corp., a subsidiary of General Ceramics, filed an application in West Germany for patent Serial No. St 7388 VIb/80b (the "grandparent application"). The application disclosed a system of five-oxide component ferrites containing Fe_2O_3, ZnO, NiO, CoO, and MnO. A range was given for these components in terms of a three-component iron-zinc-nickel oxide ferrite with the statement that Q-factor deteriorates when "iron oxide contents [fall] below 66% by weight the named combination of additives."[3]

3. We do not find it necessary to pursue the controversy between the parties concerning the meaning of this ambiguous statement.

Ferramic Q apparently met with commercial acceptance. For example, Zenith Radio Corp., on December 2, 1953, approved its purchase for use in radio antennas.

On November 9, 1954, United States Patent Application Serial No. 467,828 (the "parent application") was filed by Zerbes with the Patent Office. It disclosed that the addition of cobalt oxide made it possible to obtain ferrites with "high quality values or Q-factors in the high frequency region, 200-300 mcs, for example, which have not hitherto been attained." A triaxial diagram showed the components of the three basic oxides (Fe_2O_3, ZnO, and NiO), with Fe_2O_3 ranging from 58% by weight to 80% by weight. The application also spoke of a "preferred range" which encompassed still a smaller area of the triaxial diagram, with the weight percentages of Fe_2O_3 ranging from 62% to 80%. Moreover, the application stated that the products of the invention, without manganese oxide additions, have a proportion of Fe_2O_3 which is slightly less than 58% by weight. The application used imprecise terms to describe the quantities of the product under discussion, e.g., batch.

Table 2 of the parent application set forth the Q-factor at 1 mc. and illustrated dramatic increases in Q as a result of adding CoO and MnO to the basic three-oxide component ferrite.[4] Claim 2 was for a nickel-zinc ferrite con-

4. U. S. Serial Application No. 467, 828.

Table 2.

Composition in Weight percent			μ_o	Q at 1 Megacycle		Q Improvement, percent	CoO: 100 NiO
ZnO	NiO	Fe_2O_3		Without addition	With cobalt manganese additions, CoO = 0.7% of batch, MnO = 2% of batch		
12.0	16.0	72.0	60	88	153	74	4.4
16.2	4.3	79.6	60	56	124	121	16.7
22.6	11.1	66.9	250	20	63	214	6.3

taining MnO of 1-5% by weight of the total composition and 1-60% by weight of CoO based on the proportion of NiO in the composition but not to exceed 3.0% of the entire composition.

On April 25, 1955 the Examiner rejected all claims in the parent application on the ground that it was unpatentable over U. S. Patent No. 2,656,319, issued to Godshalk Berge on October 20, 1953. The Berge patent was said to disclose cobalt-nickel-zinc ferrites. The Examiner stated that although the quantity of CoO claimed was less than that claimed by Berge, the mere reduction in quantity was insufficient reason for granting a patent in the absence of unexpected results. Claim 2 was also rejected because it was indefinite, merely indicating the physical mixing of oxides.

Zerbes amended the application on October 12, 1955 in what purported to be an attempt to remedy or rectify the deficiency of indefiniteness and he asked for reconsideration of the effect of Berge Patent No. 2,656,319, filed January 3, 1949. The further attempted amendments, the abandonment of the original application and the substitution of the two continuation-in-part applications No. 754,371 and No. 754,372 and the further proceedings in the Patent Office are sufficiently described in Judge Tenney's comprehensive opinion below, 297 F. Supp. at 434-37. The net result was that the Examiner stuck to his ground and relied heavily upon the prior art, including Crowley Patent No. 2,736,708, filed June 8, 1951, Harvey Patent No. 2,723,239, filed September 29, 1952, Berge Patent No. 2,656,319, filed January 3, 1949, Albers-Schoenberg Patent No. 2,700,023, filed March 10, 1951, and a text book, College Chemistry, by A. Smith, at 643 (6th ed. W. Ehret 1946). In view of these references the Examiner could not see why the mere mixing of different metallic-oxide additives whose properties were already well understood was not "clearly within the teach-

ing of the art." But the Examiner was overruled by the Commissioner on August 25, 1961. Zerbes amended his application again on January 22, 1962 by changing the limitation in the frequency range in the claim from "200-300 mcs." to "in the high frequency range of up to 300 mcs.," and the Patent No. 3,036,009 issued on May 22, 1962.

III.

Application of the Law of Obviousness.

We follow the rubric of *Graham* v. *John Deere Co.*, 383 U. S. 1, 17 (1965). The scope and content of the prior art have already been delineated and the "level of ordinary skill in the pertinent art" has been disclosed by the foregoing discussion.

What put the whole series of maneuvers by the patentee, and the application for the patent itself, completely out of focus in the Patent Office was the failure of the patentee to disclose the existence of Ferramic N and Ferramic Q and the relationship between them. Appellant's predecessor manufactured and promoted both of these compositions with the trade before the filing of the grandparent application in West Germany. We have already set forth the chemical compositions of these two ferrites, and it is quite apparent that Ferramic Q is substantially the same as Ferramic N with the addition of a small amount of cobalt oxide (CoO). As Ferramic N contained a small amount of manganese oxide (MnO), the new product, Ferramic Q, represented no more than the addition of the small amount of cobalt oxide. Ferramic N was, of course, part of the prior art and so were the Crowley and the Harvey patents above referred to, each of which taught that the Q-factor was considerably increased by the addition of the cobalt oxide. The Stemag people may well have thought that they discovered the effect of the addition of a small amount of

cobalt oxide to a substance containing manganese oxide, which turned out to be the same as Ferramic N. But this does not negate the conclusion arrived at by Judge Tenney that a hypothetical person with knowledge of all this prior art and possessed of ordinary skill in the art of producing ferrites could be expected to add the small amount of cobalt oxide required to increase the Q-factor. We agree with Judge Tenney that this is sufficient to dispose of the issue of obviousness.

The close study of the subject matter that we have been required to make has convinced us, however, that this case presents an opportunity to develop, or at least to illuminate some fundamental principles.

Much is said by Indiana General about the search for a substance which would solve the problem caused by the deficiencies of Ferramic N. Undoubtedly, Indiana General was seeking some way to improve its product. But this record does not indicate any "long felt but unsolved needs" and the "failure of others to find a solution," such as has been the subject of comment in other cases were emphasis is placed upon commercial success.[5]

Here we have an art that was practically non-existent prior to World War II. What the physicists, chemists, chemical engineers and others skilled in this particular art, including many of those whose writings and applications for patents were referred to in the File Wrapper of the patent at issue, were endeavoring to accomplish by their experiments and researches was of a more general character and of greater utility to the public in the long run. Thus these pioneers, both in the United States and

5. *See, e.g., Goodyear Tire & Rubber Co., Inc.* v. *Ray-O-Vac Co.*, 321 U. S. 275 (1944); *Carnegie Steel Co.* v. *Cambria Iron Co.*, 185 U. S. 403 (1902); *The Barbed Wire Patent*, 143 U. S. 275 (1892); *Loom Co.* v. *Higgins*, 105 U. S. 580 (1881); *Technical Tape Corp.* v. *Minnesota Mining & Mfg. Co.*, 247 F. 2d 343 (2d Cir. 1957), *cert. denied*, 355 U. S. 952 (1958).

abroad, were seeking to discover the properties of ferrites and to make them more efficient, not to discover some means of making Indiana General's Ferramic N more merchantable or to remedy its defects.

The result of these experiments and researches was, in part, to establish that the addition of a small quantity of manganese oxide had the effect of increasing permeability[6] and that the addition of a small quantity of cobalt oxide improved the Q-factor.[7] The desideratum at all times, of course, was the ascertainment of the combination of the two that would produce the optimum joining together of a sufficient permeability with a high Q-factor. The quantities of the divalent metallic oxides to be added to an Fe_2O_3 base could vary in proportion to the investigations and experiments of an unknown but surely large number of those who were skilled in the art. If each such combination, alleged to improve upon its predecessors, is to be patentable, and regarded as not the workaday product of those skilled in the art, the statute as interpreted by the Supreme Court in *Graham* v. *John Deere Co.* would, we think, be subverted, the definition of what constitutes invention would be greatly enlarged, and the public interest would suffer. That such a view would grievously prejudice the development of this art seems plain.

In view of the above it seems but natural that many of the observations relative to the properties of various additives appear as glosses or *marginalia* to the disclosures in such patents as Crowley, which have to do with the

6. *Cf.* Harvey, Hegyi & Leverenz, *Ferromagnetic Spinels for Radio Frequencies*, 11 RCA Rev. 321, 344 (1950).

7. This was disclosed in the Berge Patent No. 2,656,319, filed January 3, 1949; Crowley Patent, No. 2,736,708, filed June 8, 1951; and Harvey Patent, No. 2,723,329, filed September 29, 1952.

Moreover, by Indiana General's own showing, it was known by November 18, 1953, the date of the specification sheets sent to the radio manufacturers with samples of Ferramic Q.

methods to be followed in the process of reducing the composition to its final form.

Thus the only difference between the prior art and Zerbes's alleged invention is the ascertainment of the proportions of manganese oxide and cobalt oxide that will produce a high quality factor and a sufficient permeability. Just what will be the exact proportions to supply the needs of particular products may require a large amount of experimentation. But this very experimentation is of the essence of the art involved in this lawsuit; it is on the level of ordinary skill in the art. This is all the more true because the practitioners of this art are, and of necessity must be highly educated, sophisticated persons who generally have at their disposal laboratory facilities and staffs of competent assistants.

Thus we hold that when the properties of the metallic-oxide additives that control the permeability and the Q-factor of a *five-component* nickel-zinc ferrite are well known to those skilled in the art, the product of individual experimentation with respect to the proportions of such additives required to produce such a ferrite with high permeability and high quality factor is not patentable. The reason for this ruling is that, as we have just said, such experimentation is on the level of ordinary skill in the art.

We limit this ruling to the subject matter before us, as we must, but see no reason to doubt that the principles we have formulated may have a wider application, especially in the field of chemistry.

The cases cited in the brief of Indiana General are all distinguishable.

White v. *Fafnir Bearing Company*, 389 F. 2d 750 (2d Cir. 1968), *affirming* 263 F. Supp. 788 (D. Conn. 1966) dealt with the use of a new material in low friction bearings. The inventor used Teflon cloth to eliminate the need

for special lubricants, resulting in a dry bearing surface in which the cloth was bonded to the resin surface of the bearing. Nobody before the inventor had used Teflon cloth as a lubricating material; other patents made claims for combinations of lubricants, none of which contained Teflon. The patent in suit provided a totally new solution to what had been for years a recurring problem.

Ling-Temco-Vought, Inc. v. *Kollsman Instruments Corp.*, 372 F. 2d 263 (2d Cir. 1967) was a case in which the patented product was conceptually different from the prior art, which failed to solve a recurring and increasingly significant problem. The basic patent in the prior art, described in the opinion as a "paper patent," used a stylus and opaque armature in an aircraft-missile tracking apparatus. The patent in suit solved the problem of the stylus's obliterating the trace on the viewing screen by eliminating the armature altogether and mounting the stylus on a transparent glass or plastic plate so positioned that it did not obstruct the beam of light in the projector when it was inscribing. Other patents relied on to show that the prior art contemplated the invention either were irrelevant or did not focus on the specific problem.

Rich Products Corp. v. *Mitchell Foods, Inc.*, 357 F. 2d 176 (2d Cir.), *cert. denied*, 385 U. S. 821 (1966) involved the patent for a whipped emulsion liquid suitable for salad or dessert toppings. The patent was upheld against an attack of obviousness because it used an emulsifier different from that employed by a prior patent. The party claiming invalidity did not prove that there was no chemical difference between the two emulsifiers. Moreover, the prior patent relegated the emulsifier to a subsidiary role as an alternate fat-soluble vehicle for the coloring constituent. In the patent in suit, the emulsifier played a role of central importance to the whippability of the product.

Georgia-Pacific Corp. v. *United States Plywood Corp.*, 258 F. 2d 124 (2d Cir.), *cert. denied*, 358 U. S. 884 (1958) involved the solution by the patent in suit of an old and serious industrial problem. Products made under prior patents were unsatisfactory and resulted in a considerable number of complaints from users. In the instant case the Crowley Patent made claims not for a specific product or range of products but for a method of producing ferrites.

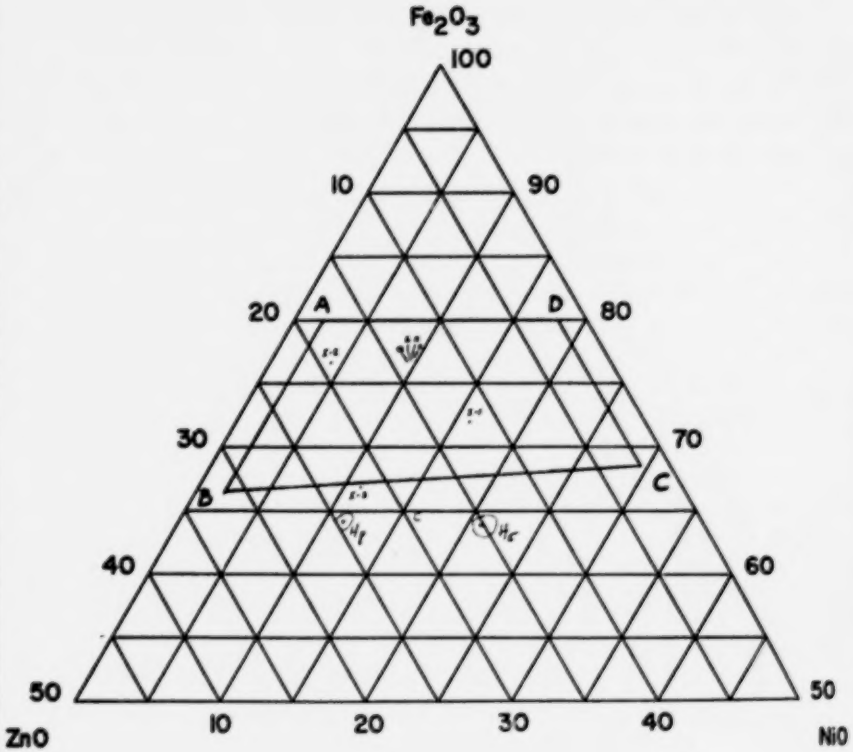
Technical Tape Corp. v. *Minnesota Mining & Manufacturing Company*, 247 F. 2d 343 (2d Cir. 1957), *cert. denied*, 355 U. S. 952 (1958) dealt with a patent combining substances, the properties of which were well known. The validity of the patent was upheld against a claim of obviousness because expert chemists had tried unsuccessfully for years to produce just such a product as was effected by the invention disclosed in the patent. The Court said (247 F. 2d at 347):

> That Drew's patent involved invention is established in several ways. It had been sought by expert chemists of the DuPont Co. and of Johnson & Johnson, for a number of years, unsuccessfully. Expanded Metal Co. v. Bradford, 214 U. S. 366, 381, 29 S. Ct. 652, 53 L. Ed. 1034; Loom Co. v. Higgins, 105 U. S. 580, 591, 26 L. Ed. 1177. In his own experiments Drew stumbled upon it. Of course, after Drew's discovery it all seemed simple. * * * [T]he demand had long existed; skilled men had sought to meet the demand without success.

The last point that Indiana General makes is that the patent in suit is not obvious because the prior art did not contemplate the specific range of components which Zerbes discovered. This argument has no merit because Zerbes

claimed a very broad range of possible combinations,[8] and in view of the foregoing discussion someone of ordinary skill in the art of producing soft ferrites could have produced a composition within the range. Furthermore, the

8. The range was so broad that one of the examples disclosed in Table 1 of the patent (identical to Table 2 of the parent application, reproduced in footnote 4, *supra*) fell outside the triaxial diagram in the patent which was supposed to represent the outer limits of Zerbes's invention. The example referred to was the last shown in the table and the one which manifested the greatest improvement in Q-factor. Designated I-3, its position vis-a-vis the range disclosed in the triaxial diagram is reproduced below in the special triaxial diagram introduced as an exhibit in the District Court.



patent in suit admittedly is one dealing with the combination of materials. The Supreme Court said in *Great Atlantic & Pacific Tea Co.* v. *Supermarket Equipment Co.*, 340 U. S. 147, 152-53 (1950) that a stringent test of obviousness for combination patents is to be applied:

> Courts should scrutinize combination patent claims with a care proportioned to the difficulty and improbability of finding invention in an assembly of old elements. The function of a patent is to add to the sum of useful knowledge. Patents cannot be sustained when, on the contrary, their effect is to subtract from former resources freely available to skilled artisans. A patent for a combination which only unites old elements with no change in their respective functions, • • • obviously withdraws what already is known into the field of its monopoly and diminishes the resources available to skillful men.

Although the patent involved in that case was for a mechanical device and the Court said that "[e]lements may, of course, especially in chemistry or electronics, take on some new quality or function from being brought into concert • • •," *id.* at 152, the test should also apply to chemical combinations. Cf. *Ruth* v. *Blue River Constructors*, 224 F. Supp. 717, 725 (D. Colo. 1963); compare *Application of Henderson*, 348 F. 2d 550 (C. C. P. A. 1965).

Applying this test, we conclude that Indiana General's argument is irrelevant. Ferramic N displayed higher permeability and Q-factor than Ferramic J. Ferramic Q, through the addition of cobalt oxide, improved the Q-factor of what essentially was Ferramic N.

IV.

The Alleged Fraud Practised Upon the Patent Office by Indiana General.

Krystinel Corporation has made a vigorous and earnest effort to induce us to reverse Judge Tenney's holding on the subject of attorneys' fees. The charge is that Indiana General and its predecessors deliberately and willfully entered upon a scheme to befuddle the Patent Office by various expedients. Judge Tenney recognized, as do we, that the conduct of Indiana General was "less than candid," but in the exercise of his discretion, viewing the situation as a whole, he balked at a finding of deliberate fraud. We have carefully studied this phase of the case, which adds further illumination to the conclusions at which we have arrived on the main issue, and we cannot find any abuse of discretion. The refusal to award counsel fees to Krystinel must stand.

What then are these alleged fraudulent practices? Probably the most important of all is the failure to disclose Ferramic N and its relationship to Ferramic Q. In view of the effect of such disclosure to Judge Tenney, and to us, it may well be that in the light of Crowley, the proceedings might have ended abruptly in final rejection of the application. But these patent cases have a way of developing in various directions; and if we approach the patent from what is stated on its face, including the triaxial diagram, the charge of willful fraud becomes more tenuous. It is insisted, however, that the terms of the patent were so ingeniously devised as to carve out a large area of monopoly without disclosing precisely how the patentee's "magnetic core body having a high Q-factor in the high frequency range of up to 300 mcs." was to be obtained. This is a serious charge, and, except for the

willful intent to deceive, the charge seems to be sustained by the evidence in the record. Judge Tenney found (297 F. Supp. at 440):

> It is the opinion of this Court, however, that neither the 1954 parent application nor the patent in suit described the invention in such a way as to permit a person skilled in the art to reproduce the preferred composition or achieve the advancement claimed by the patent without himself having to conduct extensive experimentation. If, on the one hand, all the compositions located within the specified ranges produced improved results, the specification contained in both the parent application and the parent in suit would have been an adequate teaching of the claim. However, inasmuch as only certain of the compositions, none of which was specifically set forth, falling within the described ranges produced the desired result, any person skilled in the art was left with no alternative but to experiment with a multitude of possible combinations in order to search out and discover the actual invention.

Of course it is essential that the patent disclose the alleged invention in such clear terms that any person skilled in the art can put the invention into effect. A clear showing of Indiana General's Ferramic N and Ferramic Q would have shed considerable light on the subject. But Indiana General seems to have been more interested in the acquisition of an extensive, vaguely defined monopoly than it was in demonstrating just what the invention was.

There were other strange features. The specification includes the phrase "so that high quality values or Q-factors are obtained in the high frequency range of 200-300 mcs." The similar phrase in the claim itself was amended, just prior to the issuance of the patent, to "up to 300 mcs." As Judge Tenney remarked in substance anyone familiar with the art could suppose that the patentee was represent-

ing that the alleged invention produced positive effects "falling within the specified high frequency range." When it was pointed out that Indiana General, on its own admission, could not support any such claim, and that "the useful frequency range had an upper limitation of approximately 30 mcs.," the answer made to us on the oral argument was that "up to 300 mcs." included 1 mc. This may indicate a certain furtiveness on the part of someone but it scarcely supports a charge of deliberate fraud.

The accumulation of these omissions fully supports Judge Tenney's finding that there was a lack of candor in the dealings of Indiana General with the Patent Office. It also evokes a suspicion that, if all the basic facts had been disclosed in the beginning the patent would have been summarily denied on the ground of obviousness. On the whole, however, and bearing in mind the fact that Judge Tenney saw many of the witnesses ad weighed the testimony by deposition of others in the light of the witnesses he had listened to, we cannot say that the denial of the motion for attorneys' fees was based upon any abuse of discretion. We also sustain the rulings on whether or not this is an "exceptional case" within the meaning of 35 U. S. C. Section 285, and to the effect that the showing made by Indiana General, while not measuring up to the standards of patentability, was "sufficient to support a bona fide belief in the patent's validity."

In view of the foregoing discussion, we do not reach the question of whether the four accused Krystinel products infringed the patent.

The motions submitted at the time of the oral argument are denied.

Judgment affirmed.

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APPENDIX B.

UNITED STATES COURT OF APPEALS

For the Second Circuit.

At a Stated Term of the United States Court of Appeals, in and for the Second Circuit, held at the United States Courthouse in the City of New York, on the fourteenth day of January, one thousand nine hundred and seventy.

Present:

Hon. Harold R. Medina,
Hon. Leonard P. Moore,
Hon. Wilfred Feinberg.
Circuit Judges.

INDIANA GENERAL CORPORATION and STEATIT-MAGNESIA AKTIENGELSELLSCHAFT,

Plaintiffs,

INDIANA GENERAL CORPORATION,

Plaintiff-Appellant,

KRYSTINEL CORPORATION,

Defendant-Appellant.

(and another case)

Appeal from the United States District Court for the Southern District of New York.

This cause came on to be heard on the transcript of record from the United States District Court for the Southern District of New York, and was argued by counsel.

ON CONSIDERATION WHEREOF, it is now hereby ordered, adjudged, and decreed that the judgment of said District Court be and it hereby is affirmed in accordance with the opinion of this court with costs to be taxed against the plaintiff-appellant.

A. DANIEL FUSARO,
Clerk.

APPENDIX C.

UNITED STATES DISTRICT COURT.

* * (Caption—Civil Action No. 63-479) * *

Appearances:

Davis, Hoxie, Faithfull & Hargood, Esqs., Attorneys for Plaintiffs; Richard Whiting, Esq. and James C. Wood, Esq., of Counsel.

Arthur, Dry, Kalish, Taylor & Wood, Esqs., Attorneys for Defendant; Harvey Bumgardner, Jr., Esq., of Counsel.

TENNEY, *J.*

OPINION.

This is an action arising under the Patent Laws of the United States, 35 U. S. C. §§ 283, 284, for infringement of United States Letters Patent No. 3,036,009, issued on May 22, 1962, naming Georg Zerbes as inventor and entitled "Ferro-magnetic, Ceramic Body with High Quality at High Frequency." Plaintiff seeks an injunction and damages.

After hearing the testimony of witnesses, examining the exhibits, the pleadings, the briefs and the proposed findings of fact and conclusions of law submitted by counsel, this Court makes the following findings of fact and conclusions of law.

FINDINGS OF FACT.

1. Plaintiff, Indiana General Corporation (hereinafter referred to as "Indiana General"), is a corporation organized and existing under the laws of the State of Indiana and has its principal place of business in the City of Valparaiso, Porter County, Indiana. Prior to a merger with the Indiana Corporation in 1959, plaintiff was known as "General Ceramics".

2. Steatit-Magnesia Aktiengesellschaft (hereinafter referred to as "Stemag"), a corporation which pursuant to an agreement, exchanged scientific information with plain-

tiff, was organized and exists under the laws of the Federal Republic of Germany and has its principal place of business in Lauf (Pegnitz), Germany.

3. Defendant, Krystinel Corporation (hereinafter referred to as "Krystinel"), is a corporation organized and existing under the laws of the State of New York and has its principal place of business in Portchester, Westchester County, New York.

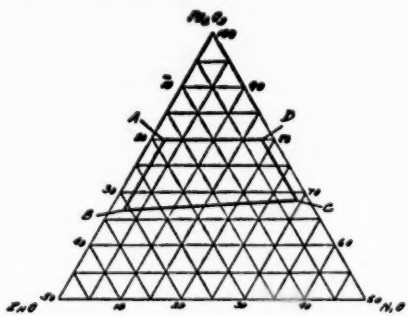
4. The patent in suit, United States Letters Patent No. 3,036,009, issued May 22, 1962, has one claim which reads as follows:

"I claim:

A magnetic core body having a high Q-factor in the high frequency range of up to 300 mcs. comprising a sintered nickel-zinc ferrite prepared by firing at about 1100°C. to about 1350°C. a composition consisting essentially of the NiO, ZnO, and the ferric oxide components set forth in weight percent within the area A-B-C-D of the drawing, said composition comprising in addition 1 to 5 weight percent of manganese oxide based on the total weight percent, and 1-60% by weight of cobalt oxide based on the proportion of nickel oxide in the said composition, the amount of cobalt oxide being within 0.1 to 3.0% by weight of the total composition, the proportion of iron oxide in said batch being at least 50 mol percent of the entire composition.'"

---

1. The drawing referred to in the claim and represented below is a triaxial diagram containing the trapazoidal figure A-B-C-D. Within the area of the trapazoid lies every nickel-zinc ferrite combination claimed by the patent in suit.



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5. Although the patent in suit claims ranges of percentages for each of its 5 components rather than describing the specific formula which plaintiff asserts produces a Q-factor of 470 at 1 mc.,[2] Table 1 of the patent in suit sets forth three examples of variations of the 5-component combination, each of which is shown to effect an improvement in the Q-factor of the nickel-zinc-ferrite system in the frequency range of 1 mc.[3]

6. More simply, the claimed invention of the patent in suit is the discovery that small additions of both cobalt and manganese to a nickel-zinc-ferrite, having an excess of 50 mol percent[4] of the iron component, enhances the Q-factor of the ferrite far more than that which is produced by adding either cobalt or manganese alone.

7. The ferromagnetic ceramic body of the patent in suit is a composition of matter generally referred to as a "ferrite". This composition results from mixing the described oxides in specified proportions, after which the mixture is

2. The term "Q-factor" or quality value is a quotient which characterizes the efficiency of the material. It is inversely proportional to and a positive way of expressing the loss factor of the ferrite body.

3. Table 1 of the patent in suit is represented below:

TABLE 1.

Composition in Weight percent				Q at 1 Megacycle			
					With cobalt manganese additions, CoO =0.7% of batch, MnO=2% of batch		
ZnO	NiO	Fe_2O_3	μ_a	Without addition		Q Improvement, percent	CoO : 100 NiO
12.0	16.0	72.0	60	88	153	74	4.4
19.2	4.2	76.6	60	56	124	121	16.7
22.0	11.1	66.9	250	20	63	214	6.3

4. A "mol" is the quantity of a substance of which its weight in grams is equal to its molecular weight. A "mol percent" is the percentage represented by the number of mols of an ingredient in a mixture or compound as compared to the total number of mols present therein.

pressed into a desired shape followed by firing or sintering at a temperature between 1100°C. and 1350°C. During the sintering process, a chemical reaction occurs to produce the ferrite. The oxide included within the claim of the patent are specified in weight percentages of the whole composition as:

Ferric oxide (Fe_2O_3)	66.5%—80.0%
Nickel oxide (NiO)	2.0%—29.5%
Zinc oxide (ZnO)	2.0%—31.5%
Cobalt oxide (CoO)	.1%— 3.0%
Manganese oxide (MnO)	1.0%— 5.0%

with the further requirement that the cobalt oxide be within the range of 1 to 60 percent by weight of the nickel oxide addition and that the ferric oxide be at least 50 mol percent of the entire composition.[5]

8. The ferrite composition of the patent in suit found particular use as an antenna rod in home radio receiving sets. An antenna is a pencil-like rod or rectangular strip made of the ferrite composition around which turns of wire are wound. The ferrite core rod presents less resistance to the passage of radio waves than does the surrounding air (spoken of as "permeability") so that broadcast radio waves pass through or near the ferrite rod. The radio

5. The references cited in the file of this patent are:

United States Patents

2,656,319	Berge	Oct. 20, 1953
2,700,023	Albers-Schoenberg	Jan. 18, 1955
2,723,239	Harvey	Nov. 8, 1955
2,736,708	Crowley	Feb. 28, 1956
2,925,388	Harvey	Feb. 16, 1960

Foreign Patents

751,623	Great Britain	July 4, 1956
752,659	Great Britain	July 11, 1956

Other References

Smith's College Chemistry, 6th ed., p. 643, pub. by D. Appleton-Century Co., N. Y. 1946.

waves, by cutting across the turns of wire, induce a current therein, which when conducted to other circuits in the radio, is amplified to audible sound. Suffice it to say that, generally, the higher the Q-factor of the ferrite material, the more efficient the antenna. As mentioned above, the Q-factor is also the reciprocal function of "loss". Therefore, since the radio broadcast signals are relatively weak and do not have much contained energy, the antenna rod material must have a low loss factor so that most of the energy which is received from the radio waves is conducted to the radio circuits.

9. During 1951 and thereafter, General Ceramics was manufacturing antenna rods for the radio industry with less than satisfactory results. Under the trademark "Ferramic", General Ceramics made and sold a material labeled "Ferramic J" which consisted of a nickel-zinc ferrite containing small additions of magnesium and manganese. Its Q-factor was relatively low and the impedance of the antenna circuit was negatively affected by the passage of time, the ambient temperature variations and the shocks normally resulting during the process of shipping the radios to market, all of which produced customer dissatisfaction.

10. During the latter part of 1952 and throughout 1953, General Ceramics was making and selling a "Ferramic N" antenna rod material which consisted of a nickel-zinc ferrite with the addition of a small amount of manganese. The chemical formula of the 4-component "N-body" by percentage weight of the total composition was as follows:

Ferric oxide (Fe_2O_3) 75.5%
Nickel oxide (NiO) 9.2%
Zinc oxide (ZnO) 13.5%
Manganese oxide (MnO)..... 1.8%

Although the N-ferrite possessed a higher Q-factor than did the "J" material, the same difficulties were experienced by the radio manufacturers with regard to the impedance of the antenna circuit.

11. Georg Zerbes, the named inventor of the patent in suit, is a resident of Germany and an employee of Stemag. In 1953, a cooperative business arrangement regarding the sharing of scientific information existed between Stemag and a subsidiary of Indiana General, Steatite Research Corporation (hereinafter referred to as "Steatite Research"), located in Keasbey, New Jersey. Dr. Albers-Schoenberg, president of Steatite Research, while visiting Stemag in August of 1953, was informed of Georg Zerbes' new ferrite formula, which information Dr. Albers-Schoenberg communicated in a letter to Salvatore Ortepio, an employee of General Ceramics (see Plaintiff's Exh. 51). The new formula consisted of (by weight percent):

Ferric oxide (Fe_2O_3 ..... 75.1%
Nickel oxide (NiO) 9.0%
Zinc oxide (ZnO) 13.3%
Manganese oxide (MnO) 1.8%
Cobalt oxide (CoO) ..... .66%

12. During the latter part of 1953, General Ceramics made laboratory samples of the Zerbes ferrite formula. Q-factors in the neighborhood of 400 were obtained, representing values significantly higher than had previously been achieved with the Ferramic J and N materials. The low temperature factor which resulted from the new product indicated that external temperature changes would not materially affect the impedance of the antenna circuit. It was expected that the new ferrite would be stable against both shock and the passage of time.

13. The first large 300 kilogram batch (designated by the formula number 2017-C) was in preparation on Novem-

ber 14, 1953. From the 300 kilogram batch, sample antenna rods were made and soon thereafter sent to certain radio set manufacturers together with a specification sheet dated November 18, 1953, identifying the ferrite as 2017-C and by the trademark "Ferramic Q". Its Q-factor was reported at 470. The chemical formula which represented the Ferramic Q material as it was marketed and sold was as follows:

Ferric oxide (Fe_2O_3)	75.1%
Nickel oxide (NiO)	9.1%
Zinc oxide (ZnO)	14.0%
Manganese oxide (MnO)	1.4%
Cobalt oxide (CoO)	.9%

(.9% CoO representing 9.7% of the NiO content)

14. A view of the history preceding and leading up to the issuance of the patent in suit, which patent is alleged to protect the above-stated formula for plaintiff's Ferramic Q material, reveals that on November 27, 1953, Georg Zerbes filed application for patent Serial No. St 7388 VIb/80b (hereinafter referred to as "the German application") in the Patent Office of the Federal Republic of Germany. This application was filed in the names of Stemag and Steatite Research.

15. The German application disclosed a range of 4-component ferrite compositions including as their principal components, Fe_2O_3, NiO, Zno and CoO. The proportions of these components were disclosed in terms of a range of basic 3-component systems (Fe_2O_3, NiO, ZnO) varying as follows:

Ferric oxide (Fe_2O_3)	58.0%—80.0%
Nickel oxide (NiO)	2.0%—40.0%
Zinc oxide (ZnO)	2.0%—40.0%

The disclosed range of CoO was "between 1 and 60% by weight of Cobalt oxide calculated as CoO with reference

to the NiO content." (See Plaintiff's Exh. 43 at 7.) However, the preferable range of the cobalt oxide component consisted of between 2 and 30% by weight based on the content of the nickel oxide.

16. The German application also disclosed a range of 5-component ferrite compositions including, as their principal components, Fe_2O_3, NiO, ZnO, MnO and CoO. The proportions of these components are similarly disclosed with reference to the above-stated ranges of the basic 3-component systems coupled with the statement that a deterioration in quality occurs when the iron oxide content falls below 66% by weight of the total composition. Although not expressly disclosed, it is assumed from the claims that the same range of CoO is desired as is disclosed with reference to the 4-component ferrites. The range claimed for the manganese oxide component was from 1 to 10% by weight of the total composition.

17. The three examples in Table 2 of the German application[6] disclose 5-component ferrites having the following compositions, by weight:

	%		
Fe_2O_3	71.5	76.6	66.4
NiO	15.9	4.2	10.9
ZnO	11.9	19.1	21.8
MnO	2.0	2.0	2.0
CoO	.7	.7	.7

6.

TABLE 1.

Composition in weight %				Q at 1 Megacycle			
					With CoO addition CoO=0.7% of the batch		
ZnO	NiO	Fe_2O_3	μ_a	Without addition		Q Improvement	CoO: 100 NiO
30.0	10.0	60.0	70	104	152	46%	7.0
12.5	20.0	67.5	50	78	128	64%	3.5
17.0	6.6	76.4	100	58	130	124%	10.6

18. On November 9, 1954, application Serial No. 467,828 (hereinafter referred to as "the original U. S. application" or "the parent application") was filed in the United States Patent Office in the name of Georg Zerbes. This application was assigned on November 2, 1954 to Stemag and Steatite Research and claimed, pursuant to 35 U. S. C. § 119, the priority date of the original German application, November 27, 1953.

19. The original U. S. application disclosed the same ranges relating to the basic 3-component system as was disclosed in the German application. The range of CoO was newly limited to from .1 to 3% based on the total weight of the composition.

20. The original U. S. application also disclosed a range of 5-component ferrites, limited to the same ranges with regard to the basic 3-component systems and restricted to the same CoO limitations as were the 4-component ferrites. Similarly, the claim prescribed an iron oxide content of at least 66% by weight of the total composition as well as a 1 to 5% by weight limitation of the manganese oxide component (see Plaintiff's Exh. 3 at 4-5). The original U. S.

TABLE 2.

Composition in Weight percent				Q at 1 Megacycle			
					With cobalt manganese additions, CoO =0.7% of batch, MnO=2% of batch		
ZnO	NiO	Fe_2O_3	μ_a	Without addition		Q Improvement, percent	CoO : 100 NiO
12.0	16.0	72.0	60	88	153	74	4.4
19.2	4.2	76.6	60	56	124	121	16.7
22.0	11.1	66.9	250	20	63	214	6.3

The above tables, both of which appear in the original German application, are shown by the patentee to illustrate examples of increases in Q-values at a frequency of 1 mc. achieved by variations of 4-component ferrites, as listed in Table 1, and variations of 5-component ferrites, as listed in Table 2.

application introduced a new statement to the effect that the claimed invention possessed "high quality values in the high frequency region, 200-300 mcs., for example." (Plaintiff's Exh. 3 at 2.)

21. On April 25, 1965, the Examiner rejected all claims in the original U. S. application Serial No. 467,828 on the principal ground that the claimed invention was unpatentable over United States Patent No. 2,656,319, filed on January 3, 1949, and issued to Godshalk Berge on October 20, 1953.

22. On April 25, 1956, and on July 4, 1956, respectively, French Patent No. 1,114,518 and British Patent No. 751,623 were published. These patents were counterparts of Zerbes' German application and disclosed substantially the same subject matter.

23. On November 5, 1956, despite a series of amendments which were made to the original U. S. application following its rejection by the Examiner, the Examiner again rejected all the claims therein as unpatentable over United States Patent No. 2,723,239, filed on September 29, 1952, and issued to Robert L. Harvey on November 8, 1955.

24. Although, by amendment, filed April 22, 1957, Zerbes amended claim 3 and added a fourth claim consisting of:

> "4. A magnetic core material of a sintered nickel-zinc ferrite, at least 97 to 99.9% by weight of said material consisting essentially of the following components: about 30% by weight of zinc oxide, about 10% by weight of nickel oxide and about 60% by weight of ferric oxide, the remaining 0.1 to 3% by weight of said material consisting essentially of cobalt oxide, calculated as CoO." (Plaintiff's Exh. 3 at 15.)

and despite Zerbes' indication to the Examiner that magnesium oxide (MgO), which is an essential component in the Harvey formula, was not contained in any of Zerbes'

own formulae or products, the Examiner, on June 19, 1957, made final his rejection of all the Zerbes claims as unpatentable over the Harvey reference on the ground that regardless of the manganese oxide addition included in Zerbes' original U. S. application, Table 2 of the patent application, *supra*, n. 5, sets forth only one specific composition which represented an improvement (Plaintiff's Exh. 3 at 18). In addition, it was the Examiner's finding that the magnesium component in the Harvey patent was not critical to his invention (Plaintiff's Exh. 3 at 26).

25. On October 10, 1957, the original German application was published for opposition as Published Application No. 1,017,521.

26. On December 13, 1957, Zerbes appealed the Examiner's final rejection to the Board of Appeals and requested an oral hearing, which was subsequently scheduled for February 17, 1960.

27. On August 11, 1958, application Serial No. 754,372 (hereinafter referred to as the "1958 application") was filed in the United States Patent Office. The application contained a new drawing (see Plaintiff's Exh. 2 at 8) in the form of the drawing contained in the patent in suit, *supra*, n. 1. The drawing and the specification each disclosed a 3-component range of compositions as follows:

Ferric oxide (Fe_2O_3)	66.5%—80.0%
Nickel oxide (NiO)	2.0%—29.5%
Zinc oxide (ZnO)	2.0%—31.5%

In the claim herein, Zerbes for the first time states that it is critical to his invention that the proportion of ferric oxide be at least 50 mol percent of the entire composition (Plaintiff's Exh. 2 at 6). The three 5-component ferrite examples from Table 2 of the 1954 parent application were carried over into Table 1 of the 1958 application despite the fact that in the third example, the ferric oxide com-

ponent was less than 50 mol percent in proportion to the entire composition.

28. Claim 1 of the 1958 application, as originally filed, read as follows:

> "1. As a magnetic core material sintered nickel-zinc ferrite of the composition within the area A-B-C-D of Fig. 1 comprising in addition 1 to 5 weight percent of maganese oxide based on the total weight percent, and 1-60% by weight of cobalt oxide based on the proportion of nickel oxide in the said composition, the amount of cobalt oxide being within 0.1 to 3.0% by weight of the total composition, the proportion of iron oxide in said batch being at least 50 mol percent of the entire composition." (Plaintiff's Exh. 2 at 6.)

29. Similarly, on August 11, 1958, Zerbes filed application Serial No. 754,371 (hereinafter referred to as "the 1958 sibling application") in the United States Patent Office. This application, like its companion application, was ultimately stated to be a "continuation-in-part" of the 1954 parent application and ultimately issued, on July 28, 1964, as United States Patent No. 3,142,645.[7]

30. In contradistinction to the 1958 application, which basically represented the 5-component ferrite matter of the 1954 parent application, the sibling application basically represented the 4-component aspect of its parent. The additional limitations found in the original 1958 application, which limitations were absent in the specification or claim of the patent, were similarly present in the 1958 sibling application with the exception of any reference to the manganese component, which component the sibling application did not claim. Examples 2 and 3 of Table 1 contained in the 1954 parent application, *supra*, n. 5, became Table 1 of the sibling (Plaintiff's Exhibit 4 at 5).

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7. A "continuation-in-part" application is one which contains matter not present in the parent case. It may add new matter to a disclosure which is identical with that of the parent case or to a disclosure which represents only a portion thereof.

31. Claim 1 of the 1958 sibling application, as originally filed, stated:

> "1. As a magnetic core material a sintered nickel-zinc ferrite of the composition within the area A-B-C-D of Fig. 1 comprising in addition 1-60% by weight of cobalt oxide based upon the proportion of nickel oxide in said composition, the amount of cobalt oxide being within 0.1 to 3.0% based on the total weight percent of said composition and the amount of ferric oxide in said composition being at least 50 mol % of the entire composition including the CoO." (Plaintiff's Exh. 4 at 6.)

32. On April 8, 1959, the 1958 sibling application was rejected by the Examiner on the principal ground that claims 1 and 2 were unpatentable over Berge Patent No. 2,656,319, issued October 20, 1953, Harvey Patent No. 2,723,239, issued November 8, 1955, Crowley Patent No. 2,736,708, issued February 28, 1956, Ateliers Patent No. 752,659 (British counterpart of the original German application), issued July 11, 1956, Licentia Patent No. 756,374, issued September 5, 1956, and Medvedieff Patent No. 1,100,865 (French counterpart of the original German application), issued April 13, 1955, all of which disclosed nickel-zinc ferrites with additions of cobalt oxide.

33. On April 16, 1959, the original 1958 application was similarly rejected by the Patent Office as unpatentable over the Ateliers patent which the Examiner cited as clearly disclosing a nickel-zinc ferrite with additions of cobalt oxide and manganese oxide within the areas disclosed by the 1958 application.

34. By amendment to the original 1958 application, filed September 25, 1959, Zerbes altered the specification to state that the application was a continuation-in-part of his original 1954 patent application and inserted a limitation in claim 1 setting forth "[a] magnetic core body having a high Q-factor in the high frequency range of 200-300 mcs. . . ." (Plaintiff's Exh. 2 at 10.)

35. On November 13, 1959, the original parent application was abandoned in favor of the two 1958 continuation-in-part applications.

36. On March 31, 1960, again the 1958 sibling application was rejected by the Examiner principally on the following grounds: (1) The claims failed to recite specific properties and a specific method of preparation; (2) the claims were unpatentable over Harvey Patent No. 2,925,388, issued February 16, 1960, which disclosed certain additions of cobalt to nickel-zinc ferrites, contemplating the amounts specified in the within application; and (3) The claims were unpatentable in that they merely added the teachings of Harvey or Berge to the ferrite of the Albers-Schoenberg Patent No. 2,700,023, filed on March 10, 1951, and issued January 18, 1955.

37. On April 6, 1960, the original 1958 continuation-in-part application was also rejected on substantially the same grounds. Regarding the manganese component, however, the Examiner stated that "[a]dding a small amount of Mn if desired to the ferrite of Crowley et al. is clearly within the teaching of the art." (Plaintiff's Exh. 2 at 16.)

38. On September 28, 1960, Zerbes amended claim 1 of the original 1958 application by inserting therein the limitations "prepared by firing at about 1100°C. to about 1350°C." and "a composition consisting essentially of the NiO, ZnO and ferric oxide components set forth within the area." Coincidentally, Zerbes cancelled claim 2 of the application.

39. On November 1, 1960, Zerbes filed a "substitute oath" in connection with his original 1958 application.[8]

8. A "substitute oath" is a sworn statement by the inventor that as to those features of his present application not disclosed in his prior application he is unaware of any public use, sale, publication or patent disclosing them more than one year prior to the filing date of the continuation-in-part application. As to the

40. On August 25, 1961, the original 1958 application Serial No. 754,372 was allowed by the Commissioner. On January 22, 1962, however, Zerbes filed an amendment changing the limitation of the remaining claim from "a magnetic core body having a high Q-factor in the high frequency range of 200-300 mcs." to one having the same quality "in the high frequency range of up to 300 mcs." (Plaintiff's Exh. 2 at 33.)

41. On May 22, 1962, the original 1958 continuation-in-part application issued as the patent in suit.

42. On or about November 19, 1962, plaintiff sent a letter notifying defendant of the existence of the patent in suit.

43. Defendant has been and presently is engaged in the manufacture of ferrite bodies, some of which are adaptable as material for antenna rods in home radio receiving sets. The four products manufactured by defendant which are accused of infringing the claim of the patent in suit are identified in the trade as K-401, K-411, K-401-1 and K-502.

44. The compositions of the accused ferrites are as follows (see Plaintiff's Exh. 41, as corrected):

Product	Component	Weight %
K-401 (discontinued November 1, 1963)		
	Fe_2O_3	74.69
	NiO	9.27
	Z_nO	13.45
	CoO	.60
	MnO	1.99

features which were disclosed in the parent application, the oath requires a sworn statement to the effect that the inventor is unaware of any public use, sale, publication or patent, existing more than one year prior to the filing date of said parent application, which disclosed any or all of those features.

K-411 (discontinued December 31, 1965)

Fe_2O_3	74.15
NiO	9.06
ZnO	14.71
CoO	.56
MnO	1.26
CuO	.26

K-401-1 (presently manufactured)

Fe_2O_3	75.67
NiO	9.40
ZnO	13.63
CoO	.55
MnO	.75

K-502 (presently manufactured)

Fe_2O_3	72.35
NiO	17.92
ZnO	8.39
CoO	.95
MnO	.39

The relationship of the cobalt components to the nickel components in the accused ferrite bodies are 6.5% of the NiO content in K-401, 6.2% in K-411, 5.85% in K-401-1, and 5.3% in K-502.

DISCUSSION.

Defendant, while denying that any of its products infringe the patent in suit, argues that the patent is invalid under 35 U. S. C. §§ 112, 282(3) for the following reasons: (1) The terms which define the single claim of the patent in suit are indefinite and ambiguous; (2) The inclusion in the nickel-zinc ferrite body of at least 1 percent of manganese oxide defeats rather than achieves the claimed functional objective of obtaining a high, or for that matter, a measurable Q-factor at frequencies up to 300 mcs.; (3) The specification does not support the functional limitation of the claim in that the patent offers

no definition as to the lower limit of the "high frequency" range, and, further, fails to set forth any specific examples of nickel-zinc ferrite recipes which accomplish the claimed utility at frequencies up to 300 mcs.; (4) The Ferramic Q composition, or the preferred embodiment of the claimed invention, which composition is the only body which evidences a Q-factor substantially improved over that which has been developed in the prior art, is nowhere disclosed either in any application or in the patent itself; (5) The claimed compositional range bears no relation to actual improvement in the Q-factor but is merely evidence of plaintiff's attempt to monopolize an unduly broad range of the nickel-zinc-manganese-cobalt ferrite system; (6) The patent in suit contains two false teachings, that is, (a) that manganese has a quality (Q-factor) improving effect on nickel-zinc ferrites, and (b) that nickel-zinc-cobalt ferrites containing up to 5% or more of manganese oxide are capable of producing measurable Q-factors at frequencies up to 300 mcs. In addition, it is defendant's contention that inasmuch as the single claim of the patent in suit contains the limitation "up to 300 mcs.", which limitation is broader than the corresponding limitation in any prior claim, and which was never sworn to by the inventor in a "supplemental oath", the patent in suit is invalid under 35 U. S. C. § 115.

Passing from a consideration of the terms of the patent in suit to questions of obviousness and anticipation, it is necessary to establish a temporal reference point, that is the effective filing date to which the patent herein is entitled, so that the state of the prior art in existence at that time can be determined. In this regard, it is defendant's principal contention that the patent in suit is entitled to an effective filing date no earlier than August 11, 1958, the filing date of the original 1958 application, inasmuch as said application contained certain claims which

were unsupported by the 1954 parent application; specifically, (1) "having a high Q-factor in the high frequency range of up to 300 mcs.", (2) "a composition consisting essentially of the NiO, ZnO and ferric oxide components set forth in weight percent within the area A-B-C-D of the drawing," the area A-B-C-D of the patent in suit encompassing in some respects a broader range of compositions, and (3) "the proportion of iron oxide in said batch being at least 50 mol percent of the entire composition." Assuming August 11, 1958 to be the effective filing date of the patent in suit, defendant argues that the patent would be clearly invalid in that Ferramic Q was in public use and being sold by General Ceramics as early as November 18, 1953, was known and used by customers of General Ceramics a few days thereafter and was anticipated by its own French, British and German counterparts which had been published on December 19, 1955, July 4, 1956, and October 10, 1957, respectively.

Even assuming, *arguendo,* that the claim of the patent in suit is entitled to an effective filing date earlier than August 11, 1958, defendant argues that such date could not be earlier than October 20, 1955, at which time an amendment to the parent application substituting the term "impurities" for the term "additions" introduced "new matter" into the file history. For the same reasons as were stated above, the establishment of an October 20, 1955 effective filing date would likewise render the patent in suit invalid.

Defendant further contends that even assuming that the patent in suit were allowed an effective filing date prior to October 20, 1955, that date could be no earlier than November 9, 1954, the filing date of the parent application, in that the parent application introduced "new matter" not supported by the German grandparent application, such as: (a) the limitation of the CoO range to "from

.1 to 3 weight percent"; (b) the limitation of the MnO range to "from 1 to 5 weight percent"; and (c) the characterization of the invention as exhibiting high Q-factors in the high frequency range of 200-300 mcs. This effective filing date, defendant alleges, would also render the patent invalid by reason of the public use and sale of Ferramic Q material more than one year prior to that date.

Finally, defendant contends that even if this Court were to determine that the effective filing date of the patent in suit were November 27, 1953, the filing date of the grandparent application, the patent would still be invalid for the following reasons: (1) Ferramic Q had been fully commercialized in the United States by General Ceramics on or about November 18, 1953 and, therefore, known and used by others in the United States prior to its date of invention; and (2) The patent in suit was fully anticipated by and obvious in relation to the teachings of the prior art.

At the risk of being somewhat repetitive, the prior art, as it existed on November 27, 1953, consisted essentially of the following compositions and patents:

Berge, No. 2,640,813 alone,
Harvey, No. 2,723,239 (pending) alone,
Crowley, No. 2,736,708 alone,
Ferramic N in view of Crowley and/or Harvey,
Ferramic N in view of Crowley and Berge or Harvey and Berge,
Berge in view of Crowley,
Berge, Ferramic N, Crowley and Harvey taken together.

It is expressly stated in 35 U. S. C. § 112 that:

> "The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention."

It has been well established that:

> ". . . the patentee is required to draft his specification and claims as precisely as the subject matter permits, and his failure to do so may result in judicial invalidation of his patent." *Georgia-Pacific Corp.* v. *United States Plywood Corp.*, 258 F. 2d 124, 136 (2d Cir. 1958).

As a corollary to that proposition, it is established as well that "a patentee cannot arbitrarily select a range in a known progressive change and maintain a patent monopoly on the products falling within that range on the ground that the designated range produces optimum results." *Georgia-Pacific Corp.* v. *United States Plywood Corp.*, *supra* at 132; *Kwik Set* v. *Welch Grape Juice Co.*, 86 F. 2d 945, 947 (2d Cir. 1936).

It appears from a careful examination of the patent in suit that with regard to its description of the claimed invention it fails to set forth the best mode contemplated by the inventor. Although the *preferred* composition, which itself may have been an advance in the development of ferrite materials, was known prior to the effective filing date of the 1954 parent application, it was effectively obscured in both the parent application and the patent in suit. Rather than disclose its specific recipe, the plaintiff merely included the elements of the preferred composition within the series of broad ranges claimed by the patent in suit, which ranges extended beyond the area representing significant technological advancement.

Specifically, on August 5, 1953, Stemag communicated by letter to Mr. Salvatore Ortepio (see Plaintiff's Exh. 51), at that time employed as project engineer for General

Ceramics, that a discovery had been made of a preferred ferrite composition which disclosed that a small addition of cobalt oxide to the basic 4-component system produced a significant improvement in both the Q-factor and the temperature coefficient of the ferrite body. The new composition consisted of:

	Weight %
ZnO	13.3
NiO	9.0
MnO	1.8
CoO	.66
Fe_2O_3	75.1

Although the letter recited that the above composition was "almost 874-body" (Ferramic N), which product was being marketed and sold by General Ceramics in the latter part of 1952 and throughout 1953, it was claimed that the slight addition of cobalt oxide in combination with the manganese oxide component effected the improvement.

After further independent experimentation was conducted by General Ceramics, the composition was modified as follows:

	Weight %
ZnO	14.0
NiO	9.1
MnO	1.4
CoO	.9
Fe_2O_3	75.1

Comparing the 1954 parent application with the patent in suit, the claims therein consist of the ranges as set forth below (within which the preferred composition is included):

Component	1954 Application	Patent in Suit
Fe_2O_3	58 -80%	66.5-80%
NiO	2 -40%	2 -29.5%
ZnO	2 -40%	2 -31.5%
CoO	.1- 3%	.1- 3%
MnO	1 - 5%	1 - 5%

Inasmuch as the Q-values at 1 mc. which were being obtained in the field varied, for all practical purposes, from approximately 63 to 170, and since plaintiff's preferred composition allegedly yielded a Q-value of 470, it appears that plaintiff's composition represented a significant advancement in ferrite development. It is the opinion of this Court, however, that neither the 1954 parent application nor the patent in suit described the invention in such a way as to permit a person skilled in the art to reproduce the preferred composition or achieve the advancement claimed by the patent without himself having to conduct extensive experimentation. If, on the one hand, all the compositions located within the specified ranges produced improved results, the specification contained in both the parent application and the patent in suit would have been an adequate teaching of the claim. However, inasmuch as only certain of the compositions, none of which was specifically set forth, falling within the described ranges produced the desired result, any person skilled in the art was left with no alternative but to experiment with a multitude of possible combinations in order to search out and discover the actual invention.

Compounding this deficiency is the fact that the examples of the 5-component ferrite system set forth in Table 2 of the 1954 application, which table subsequently became Table 1 of the patent in suit, evidence no significant technological advance over the prior art. *Supra* n. 2. The table indicates that at 1 mc., the three examples of the 5-component ferrite will yield Q-values of 153, 124 and 63, respectively. Inasmuch as Harvey Patent No. 2,723,239, issued November 8, 1955 (see Defendant's Exh. L) shows cobalt additions producing Q-values, of 178, 137 and 99, for example, and the Crowley Patent No. 2,736,708, issued February 28, 1956 (see Defendant's Exh. E, Table 1) similarly shows that at 1 mc. the addition of one part Co_2O_3 will produce a

Q-value of 80.7, somewhat higher than one of the three examples set forth in Table 1 of the patent in suit, the significant advance could not be determined by a consideration of the patent in suit in spite of the possibility that an inventive combination was lurking somewhere therein. Therefore, this Court is constrained to pronounce the patent in suit invalid for failing to comply with the requirements of 35 U. S. C. § 112.

A patent which appears to represent a modest improvement in an art in which inventive skill has not been lacking is to be strictly construed, and, thereby, confined to the language of the claim. *Garland* v. *Remington Arms Co.*, 137 F. Supp. 622, 624 (S. D. N. Y. 1956); *Filt-O-Pure Prod. Corp.* v. *Chemex Corp.*, 124 F. Supp. 22, 24 (S. D. N. Y. 1954), *rev'd on other grounds*, 222 F. 2d 424 (2d Cir. 1955). It similarly must be recognized that in order for a claim to be sustained, it clearly must recite a structure or composition which is capable of performing its purported function. *Application of Launder*, 222 F. 2d 371, 375 (C. C. P. A. 1955). Likewise, it is well settled that:

> ". . . if the claims fail to adequately define inventive features by proper limitations, they are not allowable even though the device would support patentable claims." *Application of Launder, supra* at 375-76.

The 1954 parent application recited that when the components within the various ranges were combined as set forth in the specification, it was possible to "obtain ferrites with high quality values or Q-factors in the high frequency region, 200-300 mcs., for example, which have not hitherto been attained." (Plaintiff's Exh. 3 at 2.) The patent in suit states that:

> "[t]his invention is based on the discovery that certain small additions of cobalt oxide and manganese oxide favorably modify the properties of nickel-zinc ferrites so that high quality values or Q-factors are

obtained in the high frequency range of 200-300 mcs., for example." (Plaintiff's Exh. 1.)

It must be noted at this point that although the patent in suit specifies "200-300 mcs., for example", this language was amended on or about January 22, 1962 to read "in the high frequency range of *up to 300 mcs.*" (Plaintiff's Exh. 2 at 33.) (Emphasis supplied.)

Defendant contends that the patent in suit is invalid in that the claim of high Q-value in the high frequency range of either "200-300 mcs." or "up to 300 mcs." is, in both instances, a misrepresentation or overstatement of the inventive advance. Plaintiff, on the other hand, contends that "high frequency" is a relative term which includes frequencies in the vicinity of 1 mc. as well as frequencies approximating 300 mcs. Plaintiff further contends that since the phrases "200 to 300 mcs." and "up to 300 mcs." were not included in the parent application and in the patent in suit for the purpose of describing the actual limits of the inventive advance, but merely to cite to any student of the patent an example of what "high frequency" *could be*, the fact that the specification cannot produce a high Q-value throughout the entire high frequency range described in the patent in suit would not be grounds for its invalidation.

It is inconceivable to this Court, however, that plaintiff selected the 200 to 300 mc. range or the phrase "up to 300 mcs." to abstractly describe certain frequencies which could be classified as "high frequency" without intending to imply in any way that its preferred composition or invention produced positive effects at most frequency levels falling within the specified high frequency range.

The evidence establishes without doubt that in early 1954, it was plaintiff's belief, after an evaluation of preliminary experimental data, that Ferramic Q, the preferred

composition, possessed "a useful frequency range at least up to 30 mcs." (Defendant's Exh. B-1.) Subsequently, in the Twelfth Quarterly Progress Report of the General Ceramics Corporation, covering the period between January 1, 1954 and March 31, 1954, it was reported that although Ferramic Q yielded a Q-value of 400 at approximately 1 mc., at 10 mcs. the Q-value dropped off to approximately 55 and was unmeasurable at frequencies above 20 mcs. (Defendant's Exh. A-1). With this knowledge of the effectiveness of its product, it appears evident from the facts herein that plaintiff was more interested in employing a subtle form of puffing in order to create the impression that its composition accomplished results in frequency ranges unapproached by the prior art rather than candidly admitting to the actual limitations of its claim. In effect, therefore, this is an example of a plaintiff, which, in its attempt to acquire more rights than it actually deserved, disqualified itself from obtaining those rights to which it might otherwise have been entitled.

As clearly expressed by the Supreme Court in *General Elec. Co.* v. *Wabash Co.*, 304 U. S. 364, 368-69 (1938):

> "Recognizing that most inventions represent improvements on some existing article, process or machine, and that a description of the invention must in large part set out what is old in order to facilitate the understanding of what is new, Congress requires of the applicant 'a distinct and specific statement of what he claims to be new, and to be his invention.' Patents, whether basic or for improvements, must comply accurately and precisely with the statutory requirements as to claims of invention or discovery. The limits of a patent must be known for the protection of the patentee, the encouragement of the inventive genius of others and the assurance that the subject of the patent will be dedicated ultimately to the public. The statute seeks to guard against unreasonable advantages to the patentee and disadvantages to others

> arising from uncertainty as to their rights. The inventor must 'inform the public during the life of the patent of the limits of the monopoly asserted, so that it may be known which features may be safely used or manufactured without a license and which may not.' "

Under no circumstances, therefore, may a patent be granted which describes the subject matter in such a way as to extend the monopoly beyond the invention. *General Elec. Co.* v. *Wabash Co., supra* at 371; *Helene Curtis Indus.* v. *Sales Affiliates, Inc.*, 233 F. 2d 148, 153 (2d Cir. 1956), *Kwik Set* v. *Welch's Grape Juice Co., supra.*

Inasmuch as it is the opinion of this Court that both the specification and claim of the patent in suit (as well as those contained in the 1954 parent application) were not only insufficiently descriptive but, moreover, misrepresentative as to the extent of the inventive advance, the patent in suit must be declared invalid on its face. It should be restated at this point, however, that this Court is not necessarily finding that the plaintiff did not in fact develop a patentable invention. It is merely the conclusion of this Court that by virtue of plaintiff's failure to sufficiently disclose its preferred composition and its attempt to monopolize a greater part of the nickel-zinc ferrite field than it was rightfully entitled to, plaintiff has lost whatever rights it might have had to patent protection.

Assuming, *arguendo,* that the patent in suit were valid on its face, its single claim would be entitled to an effective date of invention no earlier than August 11, 1958, the filing date of the continuation-in-part application, in that the 1958 application (Plaintiff's Exh. 2) contained certain "new matter" unsupported by the disclosures of the 1954 parent application.

A continuation-in-part application is not entitled to the benefit of the earlier filing date of its parent application

where the changes included within the subsequent application is "new matter" which either alters the substance of the invention or makes the compostion an invention for the first time, as opposed to the situation in which the subsequent application merely contains either a language change not affecting the meaning of the prior application or a specification which narrows the scope of that which was previously claimed. *Application of Moreton,* 312 F. 2d 954, 957 (C. C. P. A. 1963); see *Indiana Gen. Corp.* v. *Lockheed Aircraft Corp.,* 249 F. Supp. 809, 821 (S. D. Cal. 1966); *Application of Ruscetta,* 255 F. 2d 687, 691 (C. C. P. A. 1958).

The 1954 parent application fails to support the continuation-in-part application filed in 1958 (which subsequently matured into the patent in suit) in two principal respects: (1) The limitation requiring that the ferric oxide be at least 50 mol percent of the entire composition, as set forth in the 1958 application and in the patent in suit, is not supported by the "66% by weight" limitation of the parent application; and (2) The claim of the compositions' effectiveness in the high frequency range of "up to 300 mcs." is unsupported by the language contained in the parent application to the effect that the inventive advance produces high Q-values "in the high frequency range of 200-300 mcs., for example."

The criticality of the "50 mol percent" limitation in the patent in suit is expressed as follows (see Plaintiff's Exh. 1):

> "The lower line B-C of the quadrangle is just above the 50 mol percent line for Fe_2O_3. It has been found that at least enough ferric oxide should be present to react with all the bivalent oxides in the composition *including* ZnO, NiO, CoO and MnO when the latter are added. Thus, the composition employed will be above the line B-C but need be only slightly above this line when amounts close to the minimum required for CoO

> and MnO are added. The excess of ferric oxide over the 50 mol percent based on the nickel and zinc content is important because it has been found that ferric oxide reacts preferentially with nickel oxide and zinc oxide before it reacts with cobalt oxide and manganese oxide and for the cobalt oxide and the manganese oxide to be effective at least a major portion thereof should be in the form of a ferrite." (Emphasis supplied.)

Therefore, it appears that the 50 mol percent concept requires the addition of varying amounts of ferric oxide depending upon the amounts of manganese and cobalt added to the composition. Naturally, since all the oxides must be in the form of a ferrite, the greater the amounts of cobalt and manganese added to the composition, the greater is the amount of ferric oxide needed to cause the required reaction. A consideration of the parent application in light of the evidence adduced at trial leads this Court to the conclusion that the "66% by weight" limitation is a fixed concept relating solely to the 3-component nickel-zinc ferrite system without dependency upon the manganese and cobalt components. This is evidenced by the clear statement in the 1954 parent application file wrapper (Plaintiff's Exh. 3 at 5) that "[i]t will be realized that the cobalt oxide component is added to the material in the enclosed area of Fig. 1 without increasing the proportion of Fe_2O_3." Consequently, by virtue of the fixed concept described in the parent application, that which was claimed to be necessary in the continuation-in-part application would not necessarily be followed in the methodology set forth in the parent application.

In passing to the second unsupported aspect of the 1958 application, it appears obvious that had the original "200-300 mcs." been merely intended as nothing more than an example of high frequency, there would have been no need to change it. It certainly seems to be as much of an example of high frequency today as it was in 1954. The plain

fact is that plaintiff's composition never yielded a Q-value in the frequency range of 200 to 300 mcs. Therefore, in order to include within the claim that range of frequencies throughout which plaintiff's preferred composition did in fact produce a positive effect, while, at the same time, desirous of preserving the impressive but irrelevant 300 mcs. limitation, plaintiff executed the amendment. In other words, plaintiff, in its 1958 application, for the first time included within the terms thereof the relevant frequency range within which plaintiff's invention achieved a significant advance, although that range was still camouflaged within the much broader irrelevant range extending all the way up to 300 mcs.

Thus, since the patent in suit would under no circumstances be entitled to an earlier effective date than August 11, 1958, it would, in any case, be invalid pursuant to 35 U. S. C. § 102(b).

Even if this Court were to assume further, however, that the patent in suit was entitled to the effective date of the original German application, that is, November 27, 1953, this Court would still be constrained to find the patent invalid, pursuant to 35 U. S. C. § 103, in that the claim is "obvious" when considered in the light of the prior art in existence at that time.

Title 35 U. S. C. § 103 provides:

> "A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the difference between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made."

In determining which references cited by the defendant fall within the definition of "prior art", it must be recognized that:

> "... the 'prior art' referred to in section 103 includes, along with the patents, printed publications, public uses and sales of paragraphs (a) and (b) of section 102, *prior invention* as established by a coending application, *if* it becomes a patent, as contemplated in paragraph (e) ... Such prior invention, as prior art, may be combined with other references to sustain a rejection for obviousness under section 103." *Application of Harry*, 333 F. 2d 920, 923-24 (C. C. P. A. 1964).

Title 35 U. S. C. § 102(a)(e) provides in pertinent part:

> "A person shall be entitled to a patent unless—
>
> (a) the invention was known or used by others in this country ... before the invention thereof by the applicant for patent, or
>
> • • • • •
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent. ..."

Thus, for a patent to be invalid for obviousness under 35 U. S. C. § 103, it need not be anticipated in its entirety by a single reference but may be invalidated by a combination of references, such as an invention previously known and used by others in this country together with a patent in existence prior to the filing date of the application for the patent in suit. *Application of Harry, supra* at 924; see *Application of Land*, 368 F. 2d 866, 877 (C. C. P. A. 1966). However, a reference consisting of an invention which has been "known and used by others in this country" prior to the application of the patent in suit is only valid if the aforesaid "knowledge and use" is of a public nature. *Application of Hilmer*, 359 F. 2d 859, 878 (C. C. P. A. 1966).

Without indulging in an extensive analysis of each reference cited by the defendant as being prior art, let it suffice to say that plaintiff's Ferramic N material, which had been sold commercially during the latter part of 1952 and throughout 1953 (and therefore publicly "known and used"), when considered in the light of United States Patent No. 2,736,708 to Crowley, filed June 8, 1951 and issued on February 28, 1956, renders the patent in suit "obvious" as of November 27, 1953 to any person having an ordinary skill in the art of nickel-zinc ferrite development.

The Ferramic N body, as of November 18, 1953 (see Plaintiff's Exh. 50) consisted of the following composition:

	Weight %
NiO	9.2
ZnO	13.5
Fe_2O_3	75.5
MnO	1.8

The Ferramic Q body, which is virtually identical to Ferramic N, with the exception of minor variations for the purpose of adjusting the composition to the small addition of cobalt oxide, consisted of (see Plaintiff's Exh. 44):

	Weight %
NiO	9.06
ZnO	14.05
Fe_2O_3	74.14
MnO	1.40
CoO	.88

The similarity of compositions is not only evident to this Court but, moreover, was recognized by Dr. Albers-Schoenberg in his letter of August 5, 1953 to Salvatore Ortepio (see Plaintiff's Exh. 51) in which he stated that the Ferramic Q composition was "almost 874-body" or, as it is

referred to in the trade, Ferramic N. Although Dr. Albers-Schoenberg was referring to the Ferramic Q composition as originally proposed, that composition was no more dissimilar to the Ferramic N body than was the composition of Ferramic Q which General Ceramics finally released on the commercial market.

The Crowley patent (Defendant's Exh. E) taught that small additions of cobalt oxide enhanced the Q-value in nickel-zinc ferrite compositions. With specific reference to Table 1 of that patent,[9] Crowley set forth figures which indicate that a significant rise in Q-value takes place when anywhere from .1 to 3 parts cobalt oxide is added to the basic composition. As clearly specified, the addition of .1 part of cobalt oxide will increase the Q-value at 1 mc. from 62 to 74.1. The Q-value reaches 80.7 with the addition of approximately 1 part cobalt oxide, falls off to 75.2 with the addition of 3 parts cobalt oxide (still a significant degree of improvement) and loses all its improved Q-value with any further increase (above 3 parts) of the cobalt component. It is no wonder, therefore, why it is that the patent in suit claims the addition ". . . of cobalt

9.

TABLE 1.

Parts Co_3O_4	Cobalt oxide (Co_3O_4) as the additive agent									
	50 kc.		1 mc.		10 mc.		20 mc.		50 mc.	
	Q	μ^e	Q	μ^e	Q	μ^e	Q	μ^e	Q	μ^e
0	176	2.85	62	6.41	47.5	4.52	20.8	3.21	17.5	1.58
0.1	221	3.12	74.1	6.45	65.7	5.15	23.3	3.15	18.8	1.54
0.2	212	2.84	79	5.98	103	4.50	30	3.03	21.4	1.53
0.3	212	2.94	78	6.09	129	4.71	36.6	3.06	21.4	1.52
0.4	212	2.89	78.5	6.02	139	4.60	40	3.04	22.7	1.51
0.5	212	2.91	78	6.06	141	4.07	41.6	3.06	22.1	1.53
0.6	205	2.83	78	5.88	155	4.48	64.4	3.01	24.7	1.51
0.7	204	2.81	79	5.84	154	4.46	74	3.00	24.7	1.53
0.8	205	2.91	78	5.95	159	4.46	86	3.04	24.6	1.54
0.9	206	3.04	76	6.09	159	4.95	89.4	3.06	24	1.55
1	199	2.77	80.7	5.64	151	4.38	91	2.97	27.5	1.54
3	168	2.54	75.2	5.00	132	3.92	116	2.73	84.4	1.47
5	141	2.45	66.9	4.54	107	3.49	100	2.57	93.8	1.48
10	85	2.07	50.5	3.40	67.5	2.94	70	2.50	85.5	1.31
20	62	1.63	40.5	2.37	50.9	2.08	55.9	1.68	81.2	1.19
50	54	1.21	42.9	1.39	52.5	1.34	60.6	1.19	88.4	1.05

oxide, being within 0.1 to 3.0% by weight of the total composition. . . ." It is similarly interesting to note that plaintiff's preferred composition contained .9% cobalt oxide, an amount which sits practically on top of the 1 part addition shown by Crowley to achieve optimum results.

In sum, even giving the patent in suit the benefit of the earliest possible effective filing date, that is, November 27, 1953, it must be declared invalid for obviousness under 35 U. S. C. § 103 in light of Ferramic N as viewed together with the Crowley patent.

Lastly, it should be mentioned that had this Court found the patent in suit to be valid, only defendant's K-401 ferrite composition (a product which defendant discontinued in the latter part of 1963) would have infringed it.[10]

10.

Comparison of Defendant's Products to Patent in Suit in Terms of Weight Percent of the Components.

Comp.	Ranges of the Patent in Suit	Defendant's Products K-401	K-401-1	K-411	K-502
Fe_2O_3	66.5—80 %	74.68	75.67	74.15	72.35
NiO	2 —29.5%	9.27	9.40	9.06	17.92
ZnO	2 —31.5%	13.45	13.63	14.71	8.39
CoO	.1— 3 %	.59	.55	.56	.95
MnO	.1— 5 %	1.98	.75	1.26	.39
CuO	———	——	——	.26	——

As previously mentioned in the text, a patent which represents a modest improvement in a crowded art is confined to the four corners of its claim. *Garland* v. *Remington Arms Co.*, 137 F. Supp. 622, 624 (S. D. N. Y. 1956); *Filt-O-Pure Prod. Corp.* v. *Chemex Corp.*, 124 F. Supp. 22, 24 (S. D. N. Y. 1954), *rev'd on other grounds*, 222 F. 2d 424 (2d Cir. 1955).

Comparing defendant's products with the limitations set forth in the patent in suit, it is apparent that defendant's K-411 contains .26 weight percent of copper oxide whereas the patent in suit does not include that component within its composition. Secondly, it must be noted that while the lower limitation of the manganese component in the patent in suit is 1 weight percent (of the entire composition), the manganese component added to K-401-1 is only .75 weight percent and, similarly, in K-502 is as low as .39 weight percent.

Inasmuch as this Court must give a strict construction to the limitations contained within the patent in suit, it clearly must be

CONCLUSIONS OF LAW.

1. This Court has jurisdiction of this action pursuant to 35 U. S. C. § 281 and 28 U. S. C. §§ 1338(a), 1400(b).

2. The patent in suit, United States Letters Patent No. 3,036,009, in invalid pursuant to 35 U. S. C. §§ 112, 282(3) in that the specification fails to contain language which adequately describes the best mode contemplated by the inventor of carrying out his invention so as to enable any person skilled in the relevant art to make and use the same.

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held that the inclusion of *copper oxide* in defendant's K-411 ferrite product removes it from the shadows of infringement.

The question remains, however, whether this Court, bearing in mind the degree of exactitude which can reasonably be expected from scientific measurement and the degree of unavoidable variation in the measured amounts of each component, can reasonably limit the coverage of the patent in suit to the precise amounts as stated therein.

Plaintiff argues that the lower limitation of the manganese component in the patent in suit cannot be strictly held to 1 weight percent in that the patent specifically states that:

> "With the manganese . . . oxide, it is small quantities *of the order of magnitude of 1 weight percent* of the batch, which effects the improvement, yet the manganese can be considerably increased (up to 5%, by weight of the composition, for example) without diminishing the effect." (Emphasis supplied.)

Dr. Rudolf Tenzer, presently Manager of Research of the Electronics Division of Indiana General Corporation, testified that the allowable variation of any numerical figure should be the order of magnitude of that number. For example, orders of magnitude are ordinarily defined by steps of factors of 10, *i.e.*, .1, 1, 10, 100. To establish the lines separating one order of magnitude from another, the factor of 3 should be employed inasmuch as the factor .1 multiplied by 3 equals .3, and, similarly, the next higher 10-factor or 1, if divided by 3, equals approximately .3. From that calculation, Dr. Tenzer concludes that .3 is the lower limitation of the order of magnitude of the numeral 1. Continuing further, since 1 multiplied by 3 equals 3, and, similarly, since the next higher 10-factor or the numeral 10, if divided by 3, equals approximately 3, Dr. Tenzer concludes that the upper limitation of the order of magnitude of 1 is the numeral 3. In sum, according to Dr. Tenzer's theory, the order of magnitude of 1 weight percent of

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3. The patent in suit is similarly invalid pursuant to 35 U. S. C. §§ 112, 282(3) in that the specification and related table do not support the claim of utility, *i.e.*, "up to 300 mcs."

4. The patent in suit is invalid pursuant to 35 U. S. C. §§ 112, 282(3) for overclaiming in that the claimed compositional range is not delimited by limitations corresponding to marked changes in Q-values at specific frequencies.

5. Assuming the single claim of the patent in suit were valid on its face, it would be entitled to no effective filing date earlier than August 11, 1958, in that certain of its limitations were in no way supported by the 1954 parent application, to wit:

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manganese oxide consists of any amount which falls within the range of .3 weight percent to 3 weight percent.

If this Court were to accept Plaintiff's "order of magnitude" theory as representing the expected range of variability with reference to the specific numerical range limitations, it would have to apply it to the upper limitations as well as to the lower. For example, if this Court were to accept the lower limitation of the manganese component (1 weight percent) to be any amount between .3 weight percent and 3 weight percent, likewise it would have to be accepted that the order of magnitude of the upper limitation of the zinc component (31.5 weight percent) permits the patent to cover an amount totally out of proportion to that which is actually claimed. In addition, and most importantly, the "order of magnitude" theory becomes patently academic in light of Dr. Tenzer's testimony that after extensive testing, the iron component in the amount of 74 weight percent *consistently* varied no more than .2 weight percent and, similarly, *the addition of 2 weight percent of the manganese component consistently varied no more than .1 weight percent.* It appears, therefore, that the smaller the amount of the particular addition, the smaller the expected variation thereof. Additionally, it is the expected variation as evidenced by extensive testing rather than plaintiff's proposed variation according to its abstract "order of magnitude" theory that this Court adopts as a guideline herein.

It is the conclusion of this Court, therefore, that neither defendant's K-401-1 product containing .75 weight percent of manganese oxide nor its K-502 ferrite product containing .39 weight percent of the manganese component fall either within the express limitations of the patent in suit or within the necessarily expected variations thereof.

a. "having a high Q-factor in the high frequency range of up to 300 mcs."

b. "the proportion of the iron oxide in said batch being at least 50 mol percent of the entire composition."

and, consequently, invalid pursuant to 35 U. S. C. § 102(b).

6. Assuming, further, that the single claim of the patent in suit were entitled to an effective filing date as early as November 27, 1953, it would be invalid pursuant to 35 U. S. C. § 103 on the grounds of obviousness when considered in the light of plaintiff's Ferramic N composition viewed together with Crowley Patent No. 2,736,708.

7. Finally, assuming that the patent in suit were valid, only defendant's K-401 material, a product which has been discontinued since 1963, would have been held to have infringed it.

8. Plaintiff's demand for an injunction and damages is in all respects denied.

9. The complaint is dismissed and judgment shall be entered in favor of the defendant.[11]

It is so ordered.

Dated: New York, New York, November 20, 1968.

CHARLES H. TENNEY,
U. S. D. J.

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11. Inasmuch as this Court finds no evidence of bad faith on the part of the plaintiff herein, defendant's application for counsel fees is denied. *Formal Fashions, Inc.* v. *Braiman Bows, Inc.*, 254 F. Supp. 389, 395 (S. D. N. Y.), *aff'd*, 369 F. 2d 536 (1966).

UNITED STATES DISTRICT COURT.
• • (Caption—Civil Action No. 63-479) • •

JUDGMENT.

The issues in the above entitled action having been brought on regularly for trial before the Honorable Charles H. Tenney, United States District Judge on February 29, March 1, 4, 5 and 6, 1968, and the Court at the conclusion of the evidence having reserved decision, and the Court thereafter on November 20, 1968 having handed down its opinion, findings of fact and conclusions of law denying plaintiff's demand for an injunction and for damages, and directing that judgment be entered in favor of the defendant dismissing the complaint, it is,

Ordered, Adjudged and Decreed: That the defendant Krystinel Corp. have judgment against the plaintiffs Indiana General Corp., and Steatit-Magnesia Aktiengesellschaft dismissing the complaint.

Dated: New York, N. Y., November 21, 1968.

JOHN J. DECOR, JR.,
Clerk.

[EDITOR'S NOTE:

In this Appendix, inadvertently, there are no pages numbered A62 to A69 inclusive.]

UNITED STATES DISTRICT COURT.
• • (Caption—Civil Action No. 63-479) • •

MEMORANDUM OPINION.

These are motions by plaintiff, Indiana General Corporation (hereinafter referred to as "Indiana General") and by defendant, Krystinel Corporation (hereinafter referred to as "Krystinel"), pursuant to Rule 52(b) of the Federal Rules of Civil Procedure, to amend certain findings of fact incorporated in my original opinion, dated November 20, 1968, and for additional findings of fact and conclusions of law based on the evidence presented at trial. Both motions were timely filed with this Court.

After due consideration, plaintiff's motion is granted to the extent indicated below.

Solely with regard to the Manganese oxide component, Finding of Fact No. 7 is amended to read as follows:

Manganese oxide (MnO) 1 to 5%

so as to conform precisely with the terms of the patent in suit.

The following Findings of Fact are added to this Court's prior opinion:

45. Defendant's K-401-1 material, initially manufactured during November, 1963, and which replaced defendant's K-401 material, was used and sold for the same purposes as its predecessor.

46. Defendant's K-401-1 material has had the same formula and weight percents of ingredients from its first production in 1963 to the present time, although there is evidence of at least one batch which varied from the standard formula. (See Plaintiff's Exh. 48.)

47. Defendant's K-401-1 ferrite material has been sold for uses, other than radio antenna cores, at fre-

quencies of 200 megacycles; however, the functionality of such other uses did not require the presence of a high Q-factor in the ferrite material.

Plaintiff's other proposed additions are not only unsupported by the weight of the evidence but also, in certain instances, are irrelevant to the context in which they are sought to be placed.

With regard to defendant's motion, it, too, is granted to the extent indicated and for the reasons set forth in the remaining portion of this opinion.

Finding of Fact No. 32 is amended to read as follows:

32. On April 8, 1959, the 1958 sibling application was rejected by the Examiner on the principal ground that claims 1 and 2 were unpatentable over Berge Patent No. 2,656,319, issued October 20, 1953, Harvey Patent No. 2,723,239, issued November 8, 1955, Crowley Patent No. 2,736,708, issued February 28, 1956, Steatite Patent No. 751,623 (British counterpart of the original German application), issued July 4, 1956, Ateliers Patent No. 752,659, issued July 11, 1956, Licentia Patent No. 756,374, issued September 5, 1956, and Medvedieff Patent No. 1,100,865, issued April 13, 1955, all of which disclosed nickel-zinc ferrites with additions of cobalt oxide.

Finding of Fact No. 33 is amended to read as follows:

33. On April 16, 1959, the original 1958 application was similarly rejected by the Patent Office as unpatentable over Steatite Patent No. 751,623 and the Ateliers patent, which the Examiner cited as clearly disclosing a nickel-zinc ferrite with additions of cobalt oxide and manganese oxide within the areas disclosed by the 1958 application.

Defendant's concern with the words "patentable invention", as used by this Court on page 38 of the original opinion, is unfounded inasmuch as the disputed term is preceded by the phrase "at this point", which indicates that the statement in its entirety is rhetorical in nature,

referring solely to that which had been previously discussed, and bearing no relation to my final conclusions.

Most of defendant's numerous proposed additional findings of fact have been offered with a view towards a reconsideration of whether the facts in this cause distinguish it as that kind of "exceptional case" which, pursuant to 35 U. S. C. § 285, justifies an award of reasonable attorneys' fees to the defendant herein.

The defendant argues that such an "exceptional case" exists where, it is urged, the issuance of the patent in suit was procured by fraud on the Patent Office. The specific actions taken by the plaintiff, which form the basis of defendant's contention, are as follows: (1) plaintiff represented that the claimed ferrites could achieve high Q-factors "in the high frequency region of 200-300 mcs, for example" or "up to 300 mcs", when it knew at the time that it made such a representation that the useful frequency range had an upper limitation of approximately 30 mcs; (2) plaintiff failed to disclose to the Patent Office, as prior art, its Ferramic N material, knowing its similarity to the ferrite material claimed by the patent in suit; (3) plaintiff concealed a known 35 U. S. C. § 102(b) statutory bar by making three oaths, all of which were false by reason of certain "new matter" contained within the 1958 application and in the patent in suit, which matter was unsupported by the 1954 parent application; and (4) plaintiff failed to set forth the "best mode" of its invention by purposely camouflaging its improved formula in a series of irrelevant ranges.

Although plaintiff, in its offers of explanation, denies the existence of any fraudulent intent underlying its representations to the Patent Office, a discussion with regard to these specific issues of fact is not necessary to the principal determination herein.

It is established in this District that only where the

court is convinced that the patent in suit is so wholly devoid of substance that the plaintiff could not have had a bona fide belief in its validity shall it award the defendant reasonable attorneys' fees pursuant to 35 U. S. C. § 285, *Merry Hull & Co.* v. *Hi-Line Co.*, 243 F. Supp. 45, 57 (S. D. N. Y. 1965); *Bussemer* v. *Artwire Creations, Inc.*, 231 F. Supp. 798, 805 (S. D. N. Y. 1964).

In the present case, although the plaintiff was, in the opinion of this Court, somewhat less than candid in its relations with the Patent Office, and in spite of the fact that this Court found, among other reasons plaintiff's patent invalid for "obviousness", plaintiff's claim represents an inventive advance which, although not worthy of patent protection, is sufficient to support a bona fide belief in the patent's validity, thereby removing plaintiff from the shadows of bad faith.

Nevertheless, this Court is disposed to add the following Findings of Fact to my original opinion, as requested by the defendant herein:

48. Throughout the prosecution of the parent application and the 1958 application, plaintiff represented to the Patent Office that its invention was based upon the discovery that, by the addition of CoO to the claimed range of nickel-zinc-manganese ferrites, it was possible to obtain ferrites having a high Q-factor "in the high frequency region, 200-300 mcs, for example". This assertion first appeared in the specification of the parent application, and remains in the specification of the patent in suit. In the 1958 application, this same representation appeared, ultimately, as a limitation in the claim and, after allowance of the claim, was amended to "the high frequency range of up to 300 mcs".

49. At the time this statement of utility first appeared in the parent application, plaintiff had already reported to the Signal Corps that although Ferramic Q exhibited a Q-factor of 400 at approximately 1 mc,

at 10 mcs the Q-factor decreased to approximately 55 and was unmeasurable at frequencies above 20 mcs.

50. In the oath annexed to the 1958 application, as filed, as well as in the two substitute oaths subsequently filed, Zerbes swore that the features of his invention, described and claimed in this application, and not disclosed in the parent application, had not been in public use or on sale in the United States for more than one year prior to said application.

51. The limitation in the claim of the 1958 application to ferrites containing proportions of iron oxide amounting to "at least 50 mol percent of the entire composition" was new matter not disclosed in the parent application.

52. Although plaintiff expressly recognized that the preferred embodiment (Ferramic Q) of the Zerbes discovery was "almost 874-body" (Ferramic N), a ferrite material, previously sold commercially by plaintiff, this prior art was not disclosed to the Patent Office in the successive applications for the patent in suit.

The following Conclusion of Law shall be added to the prior opinion of this Court:

10. The patent in suit is not of such a nature as to make this case an "exceptional" one for the purpose of requiring plaintiff to pay reasonable attorneys' fees to defendant pursuant to 35 U. S. C. § 285.

Accordingly, the motions by plaintiff and defendant are granted to the extent indicated herein.

It is so ordered.

Dated: New York, New York
February 17, 1969.

CHARLES H. TENNEY,
U. S. D. J.

Patented Oct. 20, 1953

UNITED STATES

2,654

MAGNETIC CORE C
METHOD OF PROD

Godshalk Berge, Chicago
Industries, Incorporat
poration of Illinois

No Drawing. Applica
Serial N

10 Claims. (

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This invention relates to magnetic cores for use in inductance tuning coils and transformers or other elements in electrical circuits and particularly for use in high frequency circuits in the television or FM, range of about 76.5 to 108 mc. and in excess of 200 mc.

It is an object of this invention to produce a magnetic core having good operating characteristics at the frequencies of operation.

More specifically, it is an object of this invention to produce and provide a method for producing a magnetic core for tuning an inductance coil over a satisfactory tuning range in the region of 100 and 200 mc. and above, while obtaining a Q of at least 80 which remains substantially constant over the entire useable range, and negligible thermal drift, measured in percent per degree centigrade, while operating over the range for which it is intended.

Another object is to produce a magnetic core having desirable operating characteristics and to provide a method for expediently and economically producing the same from commercially available raw materials combined in a novel manner to provide a molecular arrangement that imparts the desired characteristics.

A further object is to provide a new compound for the manufacture of magnetic cores which includes the combination of certain new complex compounds with various additives that beneficially alter the characteristics of the core to meet predetermined specifications.

Many tests have shown that the Q of mag-

APPENDIX G.

FERROMAGNETIC SPINELS FOR RADIO FREQUENCIES*

By

R. L. Harvey, I. J. Hegyi and H. W. Leverenz

Research Department, RCA Laboratories Division, Princeton, N. J.

Summary—Ferrospinels† are unique crystalline materials of spinel structure which are formed at high temperatures by solid-phase reaction of iron oxide and one or more of certain other metal oxides. They are ceramic-like ferromagnetic materials characterized by high permeability (up to greater than 1200), high electric resistivity (up to 10^6 ohm centimeter), and low losses at radio frequencies. Wide ranges in these and other properties are obtainable by varying the component ingredients and methods of synthesis.

While ferrospinels have been known for over forty years it is only recently that they have achieved commercial importance. In this paper here is an outline of the elementary THEORY *of ferromagnetism, and descriptions of the* STRUCTURES, SYNTHESIS, PROPERTIES, *and* USES *of some practical ferrospinels.*

Historical Review

OVER 2500 years have elapsed since the ancient Greeks made the first recorded observations on attractions and repulsions of (1) certain bodies, such as amber and paper, which may be electrostatically charged by rubbing, and (2) small pieces of iron (Fe) brought near specimens of natural lodestone (magnetite = cubic-$FeO{\cdot}Fe_2O_3$). These basic phenomena of electricity and magnetism were impractical curiosities until 1500 years later when magnetism was used in primitive compasses. It was 600 years after the invention of the compass that Gilbert discovered that this earth itself is a magnet. Thereafter, there were few desultory qualitative experiments for 200 years more until Cavendish and Coulomb commenced quantitative research on electricity. Then, another 100 years went by before the epoch-making work of such men as Volta, Oersted, Biot, Ampere, Faraday, and Henry provided the foundation for Maxwell's unifying

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* Decimal Classification: R282.3 × 541.3.

† The coined word **ferrospinel** is used to denote a *ferro*magnetic *spinel*, which is a species of non-metallic cubic crystalline material containing iron in combined form. The term ferrospinel seems doubly appropriate because the materials utilize chiefly the *spin* property of unpaired electrons. Ferrospinels are sometimes called "ferrites", a term which is inappropriate because the word ferrite has long been used to denote a form of metallic (α) iron containing a fraction of a per cent of carbon (see A. F. Wells, *Structural Inorganic Chemistry*, Oxford, Clarendon Press, 1945).

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solution as cubic-Fe_2O_3, while some Be can be distributed throughout the interstices without forming a new phase.

Table III—Characteristics of some spinels from which useful ferrospinels are prepared.

	Normal Ferrospinels		
	a (Å)	Approximate μ_i	Curie-Temp. (°C)
$CdFe_2O_4$	8.69	1.00	—
$ZnFe_2O_4$	8.42	1.00	—
	Inverse Ferrospinels		
$CuFe_2O_4$	8.37	90	410
$CoFe_2O_4$*	8.36	1.1	520
$FeFe_2O_4$	8.39	70	590
Cubic-Fe_2O_3	8.32	—	620†
$LiFe_5O_8$	8.31	30	590
$MgFe_2O_4$	8.36	60	325
Mn_3O_4-$3Fe_2O_3$	8.55	250	290
$NiFe_2O_4$	8.36	30	580

* Magnetically hard. † Extrapolated value.
a = Average value of cube edge, found in the literature, for a unit cell of 32 close-packed oxygens.

In general, solid solutions of two or more of the above materials give varied and improved electric and magnetic properties, e.g., permeability, remanence, saturation, resistivity, magnetostriction, and Q.

Synthesis of Ferrospinels

Ferrospinels are generally synthesized by mixing their constituent oxides in predetermined proportions, pressing the mixture into rigid shapes, and heating the pressed material (without melting) for several hours in a furnace. The finely divided and intimately mixed solid components react and diffuse on an atomic and molecular scale to form a new crystal structure. This is called an additive solid state reaction.[23] The procedures in the synthesis are similar for the ferrospinels listed in Table III and for their solid solutions. The nickel-zinc ferrospinels have been found to be practical for many applications and the remainder of this paper will deal almost exclusively with these materials. The synthesis is here exemplified by outlining the preparation of a typical material, such as an equimolar solid solution of nickel ferrospinel and zinc ferrospinel in a form suitable for measurement pur-